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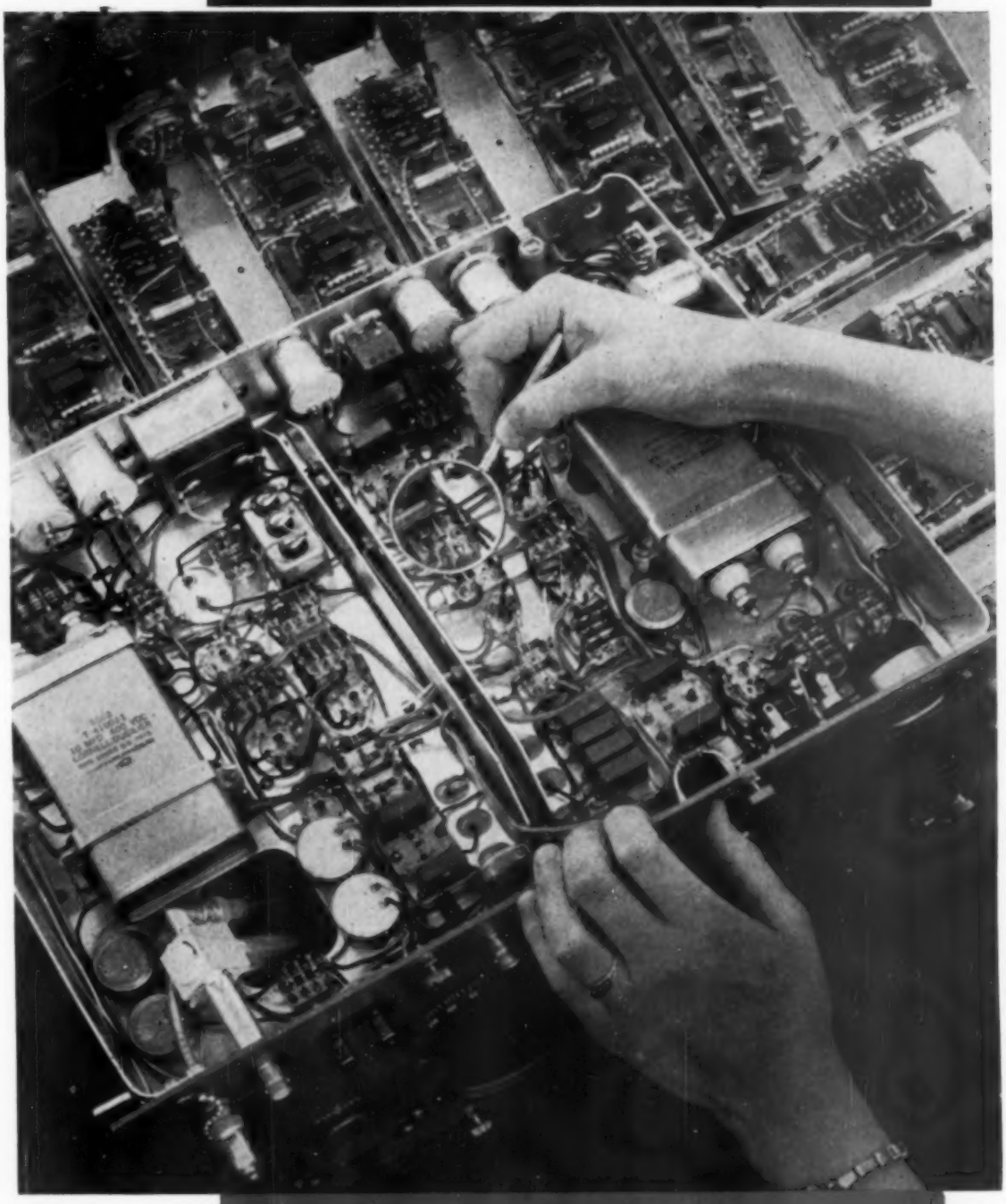
JUNE, 1958

PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING



AIRCRAFT DIRECTION FINDER USES A MELAMINE LAMINATE AS ITS TERMINAL BOARD

See Feature Story/page 555

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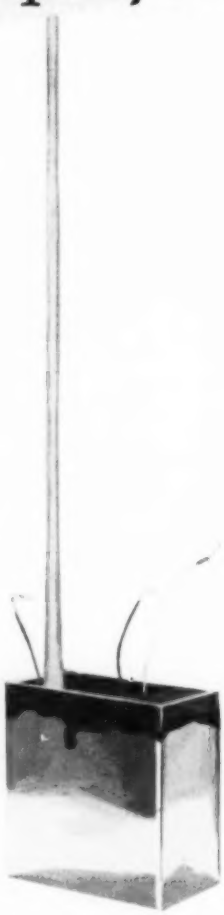
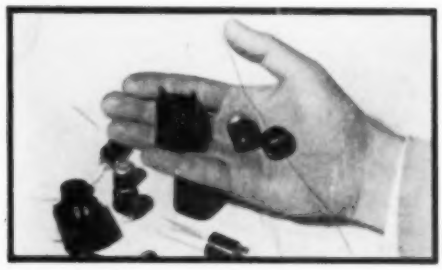
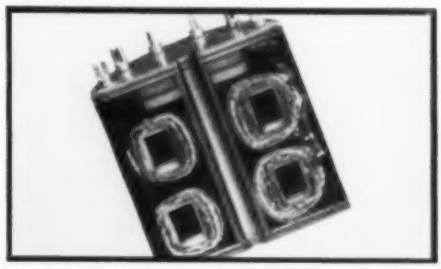




These miniature electronic components potted in Epon resin will withstand solder bath temperatures and retain excellent dimensional stability.



Sections of magnetic amplifier coils, when embedded in Epon resin, have exceptional resistance to solvents and chemicals

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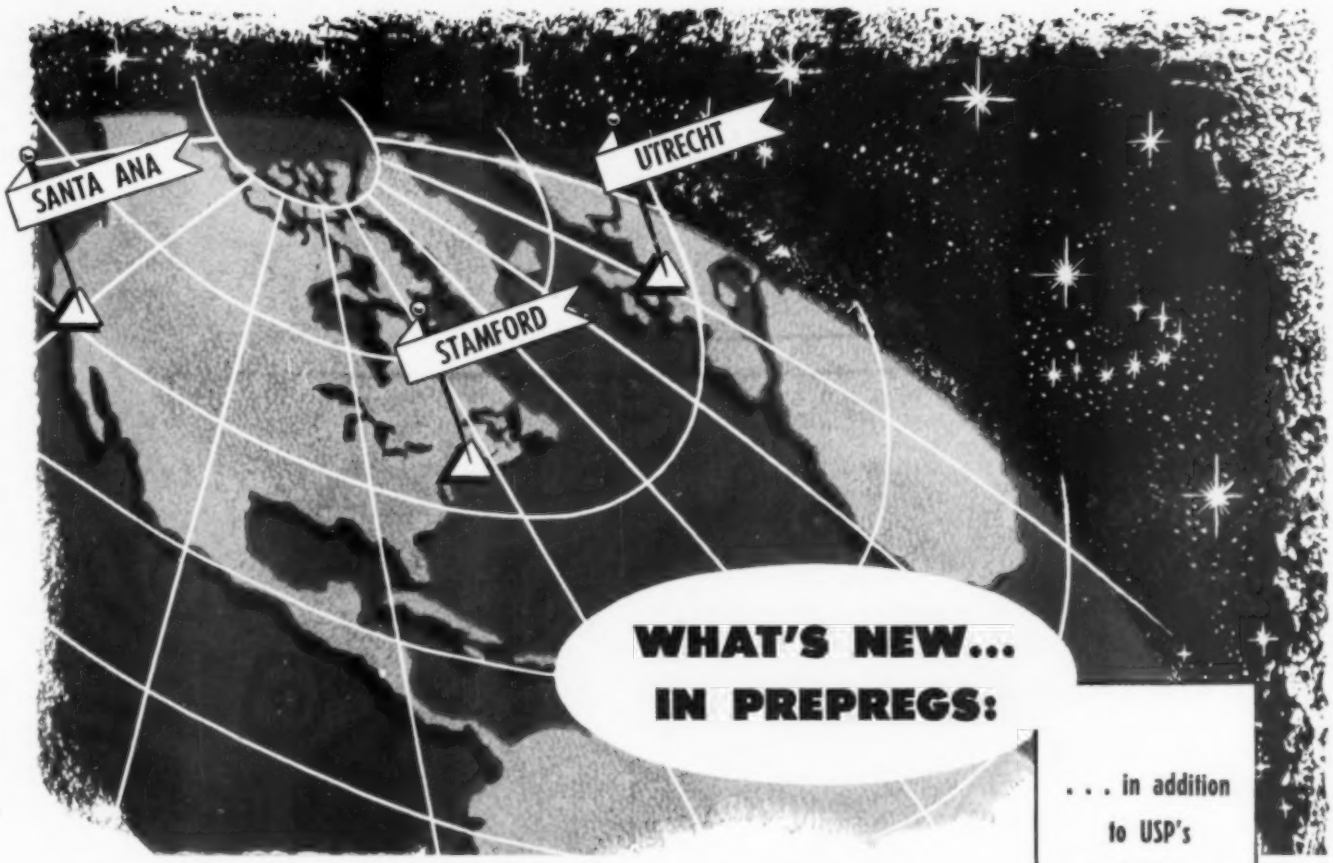

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Through continual research and development, Polymeric's staff of engineers are creating new products and processes, such as POLY-PREG T.I.O., to meet the ever-increasing demands of industry and defense.

For specific recommendations concerning materials and material specifications, engineering assistance on any individual application is available upon request. Merely write: Engineering Department, U. S. Polymeric Chemicals, Inc., Stamford, Conn.

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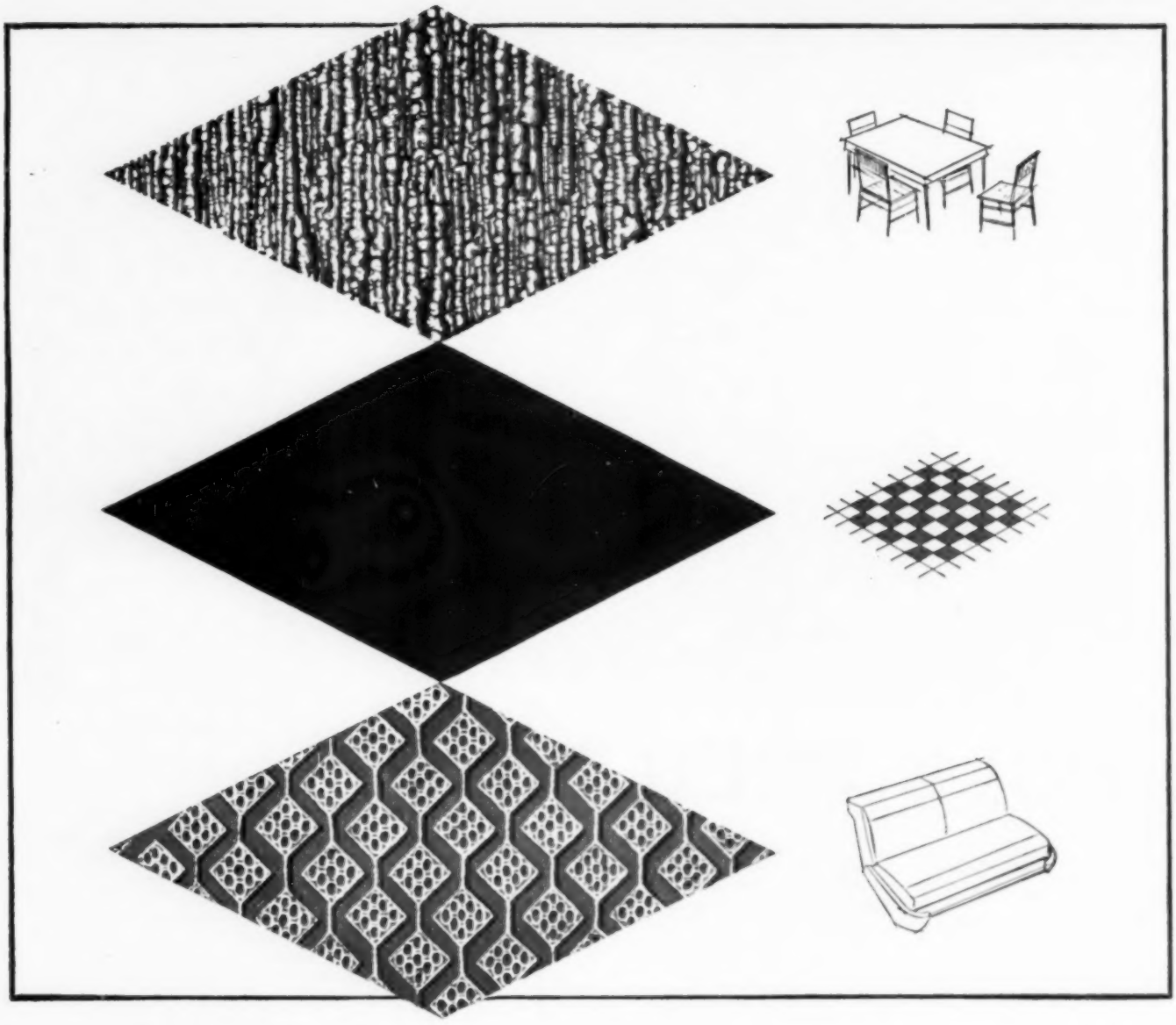

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Only a polymeric plasticizer can give your vinyl products the permanence your customers want. And of all polymerics, Plastolein 9720 is the lowest in cost.

You get versatile all-around utility from Plastolein 9720. Outstanding permanence. Easy processability. High efficiency. Excellent compatibility. You get low temperature flexibility that other polymerics fail to match. And the comparatively low viscosity of Plastolein 9720 provides added savings from bulk storage and easy handling.

Remember, Plastolein 9720 gives you polymeric *permanence*, at the lowest possible cost. Get the facts by sending the coupon below.

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Please send 32-page Emeryfacts describing the Plastolein Plasticizers.

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PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

JUNE 1958 VOLUME III, NUMBER 6

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The importance of sprue, runner and gate designs; molding temperature control; rapid mold filling; and pre-compressed molding is stressed.

542 **DIELECTRIC HEAT-SEALABILITY OF FILMS**
G. I. Addis, L. A. Rosenthal and E. Flowers
An apparatus is described that is being used in a systematic study of heat-sealing perameters for use in product control and development.

547 **NEW TECHNIQUES FOR MOLDING LINEAR POLYETHYLENE**
D. A. Jones
Recommendations are given on material type, molding equipment, and design of parts and molds for high-density polyethylene.

552 **DRY-COLORING METHODS FOR INJECTION MOLDING OF POLYETHYLENE**
J. N. Scott, C. J. Silas and J. V. Smith
Results of an investigation show that rigid polyethylenes can be dry-colored effectively and economically by using conventional equipment supplemented with a simple, inexpensive dispersion plug.

556 **INJECTION MOLDING AND EXTRUSION OF MOPLEN**
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A discussion of possible difficulties and probable causes, together with suggested remedies.

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Cover photo courtesy of: Synthane Corporation

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PUBLISHED MONTHLY BY

Plastics Technology Publishing Corp., a Division of

BILL BROTHERS PUBLISHING CORPORATION

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Letters to the Editor

Previews of Next Month

The following articles will be published in the July issue:

Physical Properties of Prepreg Laminates. Grant Brown, Vice Pres. & Tech. Director, Cordo Chemical Corp., Mobile, Ala.

Preforming Without Discoloration. R. E. Mollman, Production Mgr., Plastics Products Corp., Cleveland, O.

New Styrene for Plastics Lighting Fixtures. R. A. McCarthy, Tech. Service Rep., Plastics Div., Monsanto Chemical Co., Springfield, Mass.

Engineering Aspects of Polystyrene. P. H. Estes, III, Tech. Service Engr., Plastics Technical Service, Dow Chemical Co., Midland, Mich.

•

Highlights of this Issue

Mold Design for High-Density Polyethylene. (p. 537)

Hot runner and valve-type gating are shown to be advantageous when molding high-density polyethylene, and to be suitable for the production of large, thin sections in good, profitable cycle rates.

•

Dielectric Heat-Sealability of Films. (p. 542)

A dielectric heat-sealability test apparatus that is being used in a systematic study of heat-sealing parameters for use in product control and development is discussed in detail, together with results obtained to date.

•

New Techniques for Molding Linear Polyethylene. (p. 547)

A detailed discussion of material types, molding equipment, part design, and molds for the molding of high-density polyethylene. Emphasis is given to the spiral flow characteristics of the material and its influence on part and mold design.

•

Dry-Coloring Methods for Injection Molding of Polyethylene. (p. 554)

Results of a comprehensive investigation show that rigid polyethylene can be dry-colored effectively and easily by using a simple, inexpensive dispersion plug in conjunction with conventional equipment.

•

Injection Molding and Extrusion of "Moplen." (p. 558)

A practical discussion of possible molding difficulties, their probable causes, and suggested remedies for processing "Moplen" polypropylene.

Does Industry Misuse Engineers?

Dear Sir:

Having read your extremely interesting editorial in the May issue, I wish to express my wholehearted approval of this, your most indicative finger-lifting. It cannot be repeated often enough that negligence in solving the shortage of engineers inevitably leads to a serious backlash of general standards.

Since the evolution of the post-forming industry several years ago, I have followed most closely the problems relative to the qualitative aspect of personnel in this field.

It cannot be concealed that there is an ever-increasing tendency to avoid the employment of engineers, for some dubious reason. Preference is given in a disproportionate degree to unqualified personnel, thereby leading to the effect that technological elements become more or less isolated factors. This policy brought about most undesirable consequences. Strangely enough, these short-sighted policies seem to find continued acceptance by a large number of directors. Ironically enough, these shortages seem to persist even while industries or manufacturers are loaded with orders for equipment or products requiring advanced engineering features, not to mention the increasing pressure on delivery schedules.

It is my opinion that articles like yours should be extended into a large-scale educational program.

Gerhard Kostrzewa,
Consulting Engr.,
Franklin Park, Ill.

• • •

Copies of Foreign Articles

Dear Sir:

Can you tell us if there is any source in this country where we might obtain a reprint or photostat of an article from a foreign magazine.

Research Librarian
Dennison Mfg. Co.
Framingham, Mass.

(We print this letter only to remind others that the American Chemical Society has a photocopying service that can furnish photostatic copies of articles in foreign journals.—Editor)

Information Wanted

Dear Sir:

I am interested in plastic mixing bowls, clear, about seven inches across, and three inches high. These plastic bowls are used for counter displays of Bi-Salin Tooth Powder.

Could you let me know who manufactures these bowls—preferably a Chicago firm.

Dr. M. Segal, Dentist
Chicago 20, Illinois

(All replies received here will be transmitted to the inquirer.—Editor)

• • •

Flow Rates During Extrusion

Dear Sir:

We are engaged in custom extrusion of plastics, and are seeking information on the following problem:

We are aware that, because of friction between the flowing plastic and the die in extrusion, there is a difference in flow rates of plastic through dies (or different parts of the same die) which have different die surface-to-volume ratios. For example, the flow rate (with identical pressure) through a large circular hole is greater than through a small circular hole because of friction. We hope that someone has done some experimental work on this problem, and has perhaps come up with some results that would be useful in the design of dies.

We would appreciate any information you could pass along to us.

B. W. Brooks
Sheffield Plastics, Inc.
Sheffield, Mass.

(Our readers are invited to help the inquirer either directly or through transmittal via our office.—Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

"Quote . . . Unquote"

Organizing an Effective Safety Program

"Designing and operating a company or plant in such a way as to avoid the possibility of accidents is an economic necessity as well as a prime obligation to society. . . . This is our obligation in industry. We do not work for safety in all areas of our operations in order to reduce our insurance premiums. We work for safety so that we can plug up the loopholes which provide unnecessary losses and then we have insurance to take care of those accidental losses which, try as we might, we cannot seem to avoid from time to time. While the reduction of insurance premiums is not our purpose in accident prevention and control of consequential losses, it is of course very true that accidental loss control does contribute to reduction in our insurance premiums.

"Safety and loss-prevention can be broken down into three principal elements: (1) Accident prevention; (2) Injury or damage reduction; (3) Salvage—production recovery—rehabilitation.

"Accident prevention includes safety head-organization headed by the plant manager, supervisory development, employee placement and training and all of the other facets of a program which have to do with the actual prevention of accidents.

"Injury or damage reduction cover personal protective equipment, pressure relief on vessels, automatic sprinklers, volunteer fire brigade organization in the plant, and such secondary protective details.

"The last category applies to injured employee rehabilitation and placement of the physically handicapped. In the case of property damage, it would apply to prompt clean-up and survey and the reconditioning of damaged equipment. Production recovery would contemplate such details as the availability of spare parts and stand-by units for critical items of equipment, the lining-up of other producers of components, and the expediting of replacements. The area of plant rehabilitation . . . would include . . . process change to provide greater safety; type of building construction (outdoor vs. enclosing building construction); and plant location to localize effects and minimize future loss possibilities. The larger a company becomes, the more it becomes its own bearer of the costs of accidental losses.

"In no instances can we shrug off the cost of accidental losses by saying 'The insurance company pays.' We save ourselves money by preventing our losses."

S. F. Spence, Director, Safety & Loss Prevention, American Cyanamid Co. New York, N. Y.

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Bakelite Opens New Plastics Plant

R. K. Turner, president of Bakelite Company, with model of new polyethylene plant opened at Institute, W. Va.

A new, fully automated plant for making Bakelite high-density polyethylene is now in commercial production at Institute, West Virginia it was announced today by the Bakelite Company, Division of Union Carbide Corporation.

R. K. Turner, president of Bakelite Company said "These latest high-density polyethylene materials possess a combination of properties that will create many new markets for plastics.

"Certain housewares made from these materials will benefit from the properties of rigidity, impact resistance, high gloss and colorability imparted by high-density polyethylene. In the wire and cable field, the new materials will make possible superior abrasion resistance and thin-wall electrical insulation.

"In line with Union Carbide's practice of testing materials thoroughly before market introduction, the range of high-density polyethylene materials now available has been thoroughly tested for over a year. Property data and detailed information on fabrication techniques are available to processors," Mr. Turner said.

Another high-density polyethylene plant, located in Seadrift, Texas, will be placed in commercial production shortly. These facilities will enable Bakelite Company to supply the broadest range of both high-density and low-density polyethylene resins and compounds.

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Superior purity and resin uniformity are ensured by special control equipment, in BAKELITE's new high-density polyethylene plants.

BAKELITE high-density polyethylene automatically packaged in full-scale production. A smaller pellet size improves flow of resins.

this news—

Great new opportunities for you with new HIGH-DENSITY POLYETHYLENES!

New properties that open new markets! That's why these new BAKELITE Brand resins are big news for all processors. And don't overlook the fact that these properties have been fully tested and perfected. These new high-density polyethylenes are offered to you only after a typically thorough BAKELITE development program—a 14-month program that involved testing more than 1,000,000 pounds of these materials!

Would *higher gloss* help your product? Greater *rigidity?* Higher *heat resistance?* More *impact resistance?* These and other *tested* properties too numerous to list here are fully described in technical releases. Detailed fabrication techniques are also available. Two new plants have entered full scale production. Check your Bakelite Company technical representative *now* to discover the possibilities which these new, high-density polyethylenes offer for your operation, or write Dept. PT206 today.

Wide Range of Properties for a Broad Field of Uses

Injection Molding—Two compounds with strength and toughness at high and low temperatures for molding bottles, containers, housewares, automotive and industrial items.

Blow Molding—New compound DMDA-4901 has 4 to 5 times the stiffness of low-density polyethylene, offers reduced permeability, higher heat-distortion resistance.

Contour Extrusion & Vacuum Forming—High-density compounds with high strength and rigidity, excellent low- and high-temperature properties, ease of extrusion, outstanding batch-to-batch uniformity.

Monofilaments—High-density compounds with improved mechanical properties and heat distortion characteristics that make them especially outstanding for monofilament applications.

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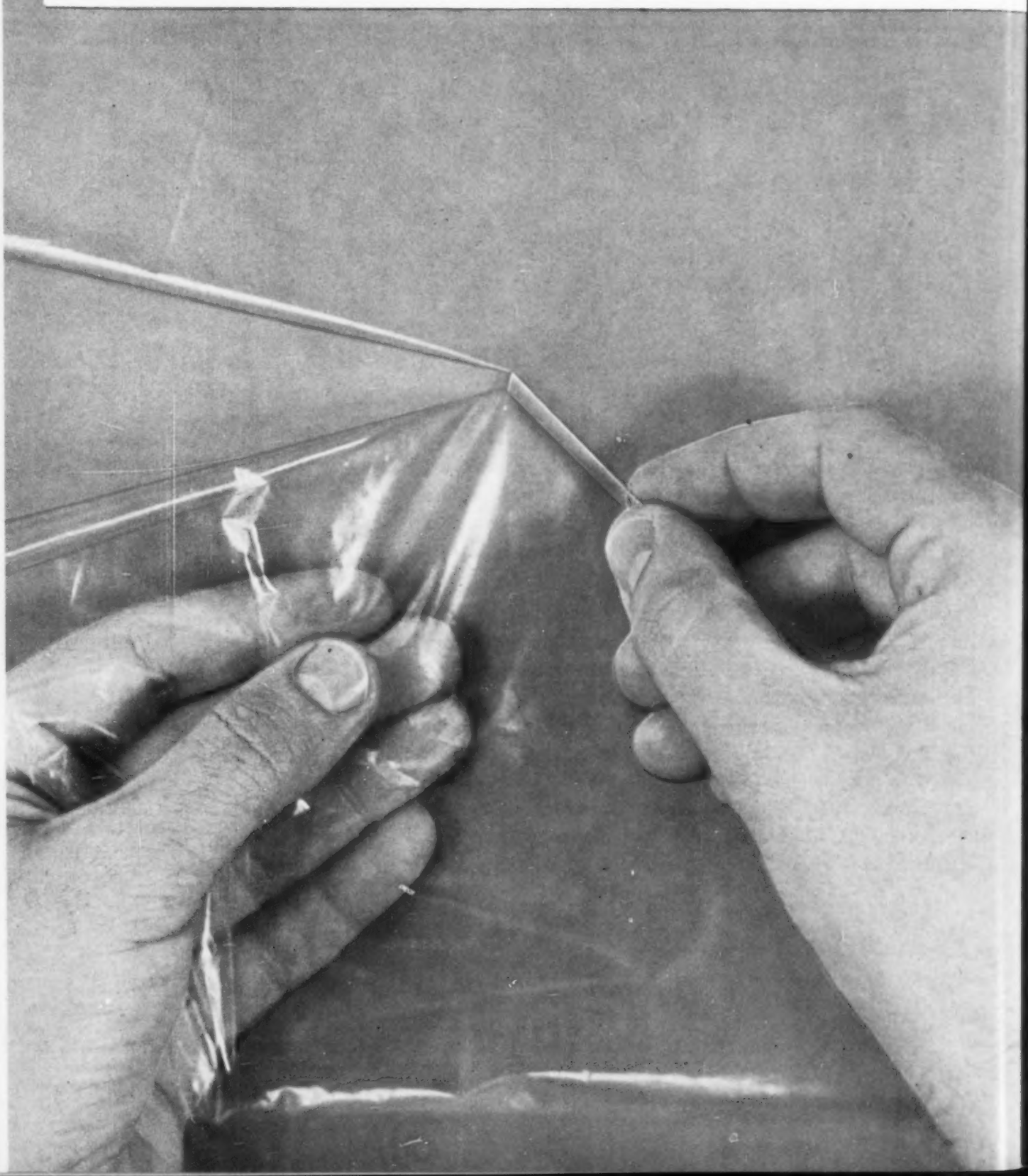
In Canada: BAKELITE COMPANY, *Division of Union Carbide Canada Ltd.,* Toronto 7, Ont.

New MARLEX* transparent breaks the packaging



polyethylene film cost barrier!

Costs 16% to 39% less than cellophane

Recent Phillips developments make it possible for film manufacturers to extrude *clear, transparent film* from MARLEX resin. And this new MARLEX film can be readily torn in a straight line *with no tear tape whatsoever!*

MARLEX film *equals* cellophane in clarity, sparkle and crispness . . . *equals* ordinary polyethylene in printability. MARLEX film as an overwrap is *far superior* to cellophane in shelf-life because it is unaffected by moisture . . . does not become brittle on the shelf. MARLEX film resists fats and grease. Freeze it! Boil it! MARLEX film can take it!

The new, low-cost, heat-sealable MARLEX film has excellent stiffness and slip. It handles efficiently in "push-through" overwrap machinery equipped to seal polyethylene. Here at last is a polyethylene film with none of the limpness, sag and blocking tendency of conventional polyethylene.

Whatever your products—baked goods, candy, cigarettes, frozen foods, cereals—you can now package them *better* for *less* money in MARLEX film.

If you *make* film . . . if you *use* film, get in touch with our nearest Plastics Sales Office for full information.

No other type of material can serve you so well in so many different ways at such low cost.

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*MARLEX is a trademark for Phillips family of olefin polymers.

Bread and other baked goods stay oven-fresh longer when packaged in sparkling clear, low-permeability MARLEX film. This economical film is readily printed and heat-sealed.

Candy, nuts and other foods last longer on the shelf when sealed in MARLEX film. If creamy, they won't dry out. If crisp, they won't get soggy. Fine for window packages.

Cereals, crackers and various soft goods packaged in boxes maintain their original fresh appeal with MARLEX film overwrap. It's also available in appealing *colors!*

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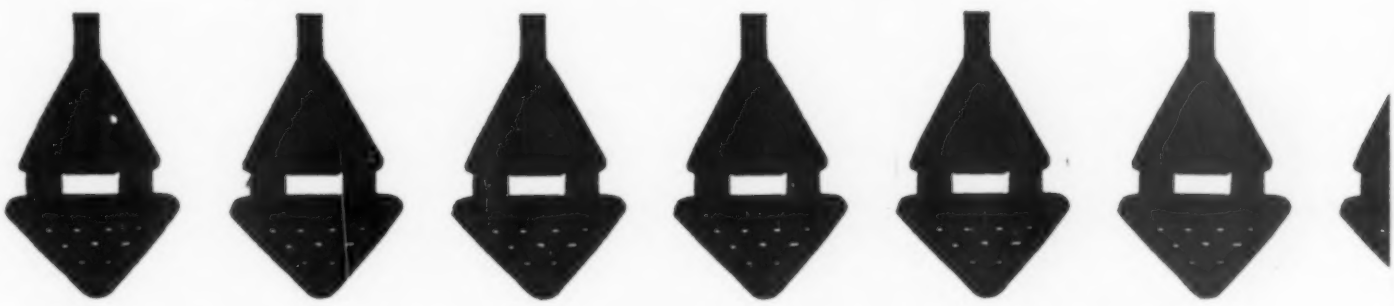
New shaker top of **TENITE POLYETHYLENE** sells more salt for Morton



A simple packaging improvement that lets a housewife *sprinkle* salt right from the container has given Morton Salt Company an important sales lead in market after market.

The new patented shaker device, fitted into the top of the salt package, consists of sprinkler and self-hinged sprinkler-cover, molded all in one piece. The material is Tenite Polyethylene in a formulation which affords just the right stiffness to keep the cover erect when open, and ample toughness to guard against breaks in the hinges.

The desired blue color is achieved by using a Tenite Polyethylene color concentrate, added in fixed proportion during the molding process. By this means, Morton secures uniform color results while employing several different molders.

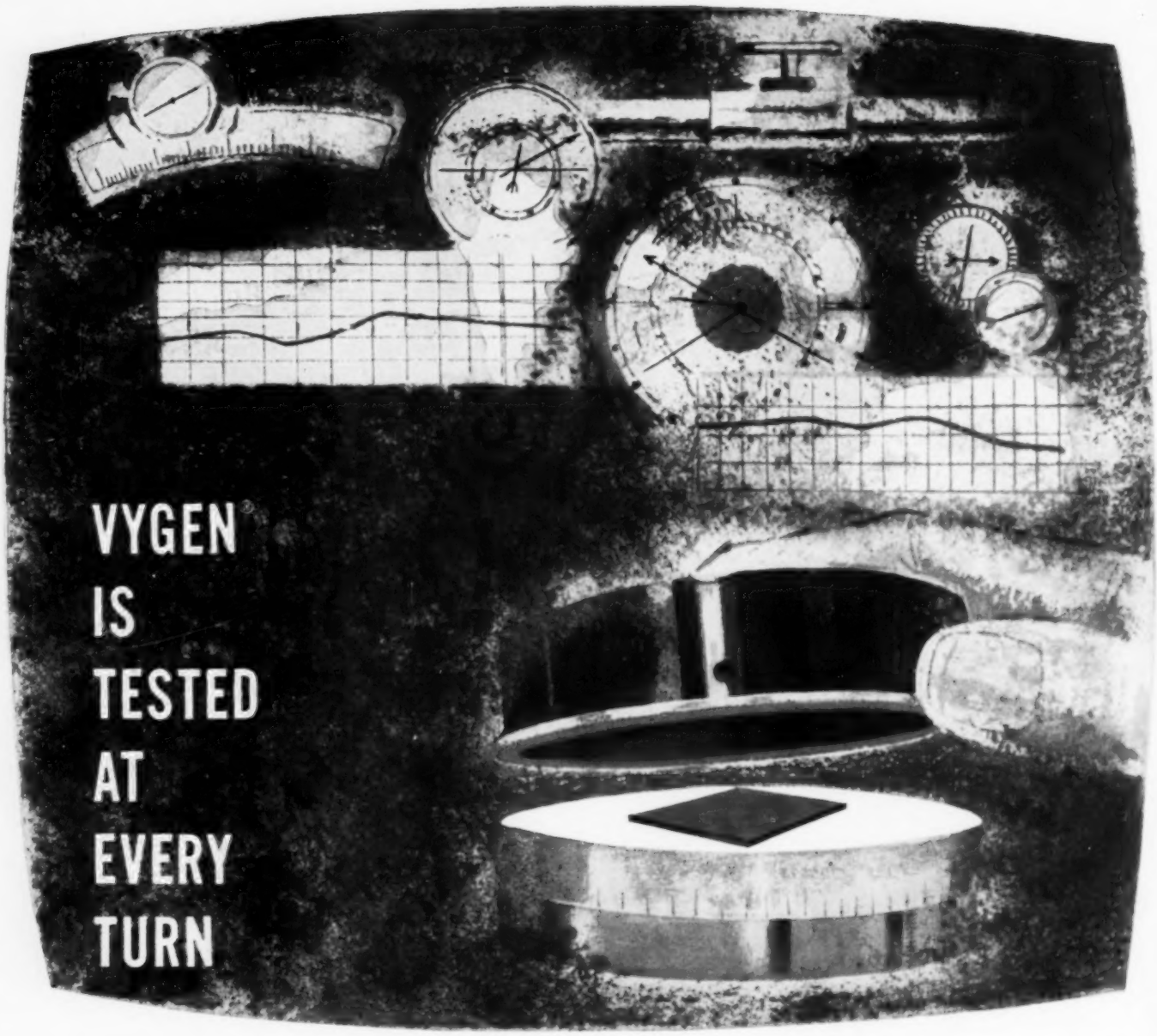
In Tenite Polyethylene, the Morton Salt Company also found the more general characteristics needed to make the idea practical. First of these were low material cost and ease of fabrication. Important, too, were resistance to corrosion by salt or water; moldability that would permit one-piece design; and resilience that would make possible a tight friction-fit between cover and sprinkler.

The shaker top is a good example of how the many useful properties of versatile Tenite Polyethylene can satisfy design needs. If you have a design—or even just an idea—that could be given effective reality in polyethylene, why not look into the possibilities offered by Eastman's wide range of formulations.

For more information on Tenite Polyethylene and advice about its use, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Shaker top molded for Morton Salt Company, Chicago 3, Ill., by: Korris Products, Inc., Lyons, Ill.
Victory Manufacturing Co., Chicago 12, Ill.
Northwest Molded Products Corp., Skokie, Ill.
Ken Hagen Co., Shelburn, Ind.
Federal Tool Corp., Chicago 45, Ill.

TENITE
POLYETHYLENE
an Eastman plastic



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From raw materials through glass-lined equipment to your plant —every phase of the Vygen production operation is planned and supervised through extensive testing to give you a perfect product. Outstanding quality and absolute uniformity makes Vygen resins and compounds right for any job, regardless of size, equipment or technique. Vygen is carefully checked before you get it, to make sure your finished goods are the very finest.

Both application-tested and UL-approved, these two members of the Vygen family are ideally suited for wire insulation and jacketing. Specify the one that fits your requirements.

VYGEN 120 resin — For fast, flawless dry-blend extrusion, using monomeric or polymeric plasticizers. It has a narrow range of particle-size distribution, fast rate of solvation, and outstanding heat stability.

VYGEN 6812 compound — Pelletized, ready for extrusion in black, white, or natural. Proved for 60° C T&TW in oil and 80° C appliance wiring applications, this material has a specific gravity of 1.32 and takes to the toughest jobs with ease.

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PLASTICS TECHNOLOGY

JUNE, 1958

EDITORIAL: Standardization, Bit by Bit

In the May issue, we published the first installment of PLASTICS TECHNOLOGY's new special feature. This feature will cover the different classes of plastics processing machinery and plastics materials, with detailed comparative specification and design data on each class of machines and materials.

The May issue dealt with 1958 Injection Molding Machines and, in addition to a lengthy comparative tabulation of specification data on available injection machines, contained a special introductory article written by Gordon B. Thayer, of Dow, on "What a Plastics Engineer Should Look For When Planning to Buy an Injection Molding Machine." Gordon is a member of our Editorial Advisory Board and a recognized authority on injection molding, and his article was thought-provoking, to say the least.

The next installment in the series will be on extrusion machines, and will be published in our September issue. Here, too, the comparative specification data on available extruders will be accompanied by a special introductory article discussing the points to be considered by a plastics engineer when planning to buy a new extruder. This article will be written by R. E. Monica, Dow's Plastics Technical Service specialist on extrusion.

•

The relatively new plastics engineer might well ask why the long delay from May to September between the first and second installments in the series. The more knowing will understand, however, that each tabulation represents months of work in arriving at a standardization system for each class of machines that can serve as the basis for a comparative tabulation of machine specifications that will be of value to plastics engineers.

The injection machine tabulation took four months of work, but we are starting to wonder if four months will be enough to establish a standardized system of extruder specification. We knew, of course, that standardization work had not progressed far—this is the understatement of the year. Judging from our experiences with the series, we would say that standardization is literally almost non-existent.

•

We embarked on the series only after lengthy study of the problem and the crying need for worthwhile comparative data that could be used by plastics engineers in promoting the future growth and continuing advance of the plastics industry. All of us in plastics stands to gain, so it is not surprising that everyone—machinery manufacturers, material suppliers, and plastics engineers involved in plastics processing and fabricating—has cooperated with us and given freely of his time and effort in trying to overcome the problem and arrive at a solution that can serve as a landmark for future work on standardization, so badly needed.

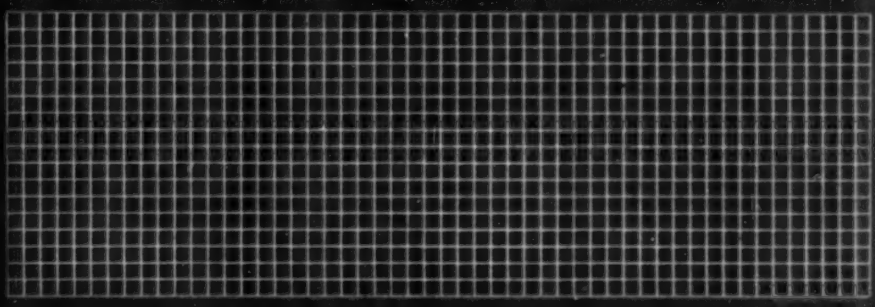
Just watch our smoke! Naturally, the "our" is the entire plastics industry.

Arthur M. Merrill

Editor

WHAT THEY'RE BOTH SAYING ABOUT NEW LUSTREX* PERMA TONE STYRENE

Lighting Fixture Molders: "Easy flow, fast cycles . . ." "No molding job too difficult." "Constant color during molding . . ."



Lighting Fixture Manufacturers: "2 to 3 times more resistant to yellowing . . ." "Exceeds IES–NEMA–SPI specs for light stabilized styrene." "Excellent crystal clarity . . . unlimited color possibilities."

ne development of Lustrex perma ne further accelerates the trend the lighting market toward yrene. To all the inherent vantages of styrene—the large eas of illumination, the light ight, good diffusion, unusual sign effects—is now added cellent light stability, a resistance yellowing up to three times better an regular styrenes. And the low lor level of perma tone opens up de new dimensions in color, cluding truly translucent whites d other difficult colors.

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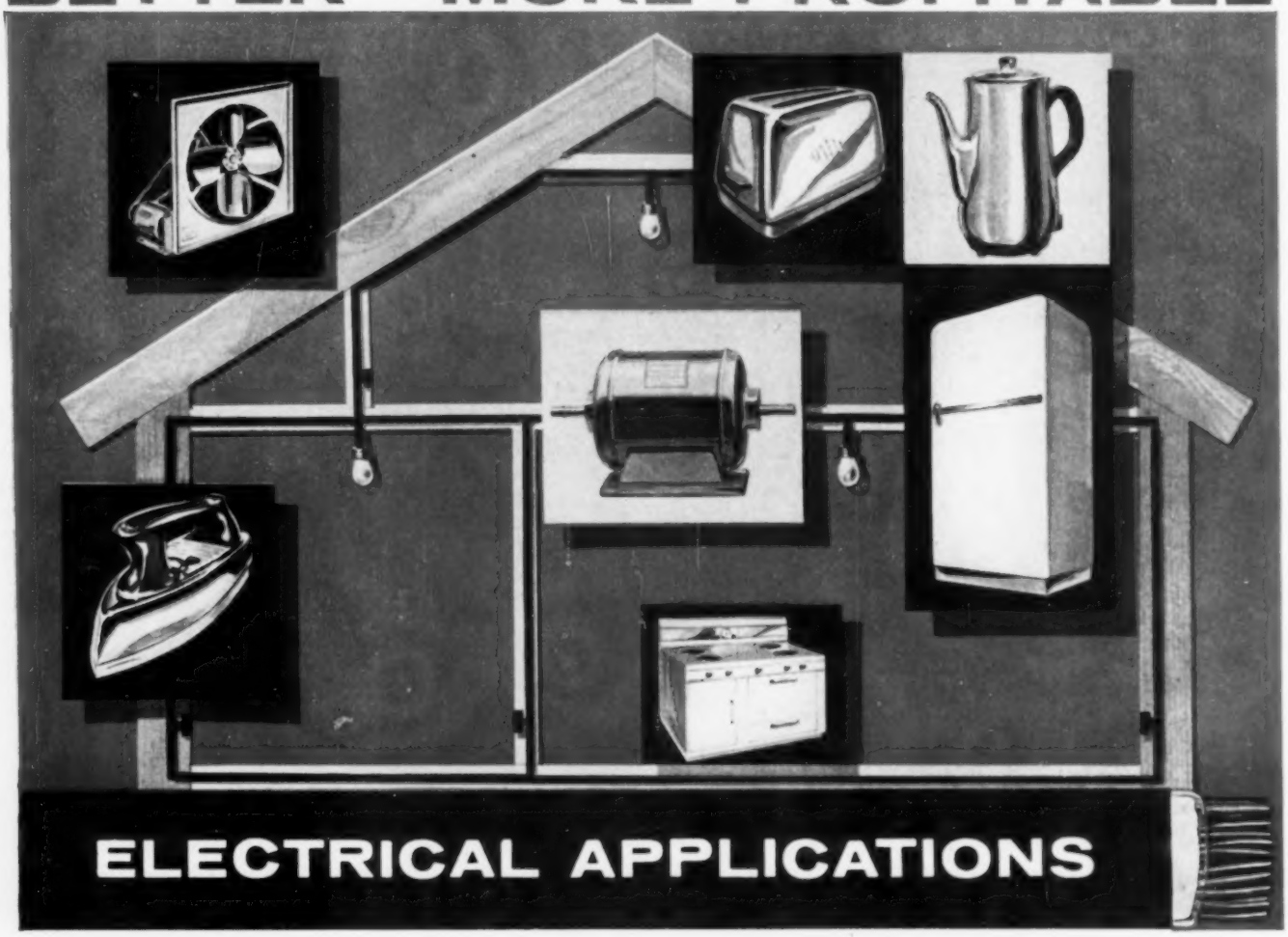

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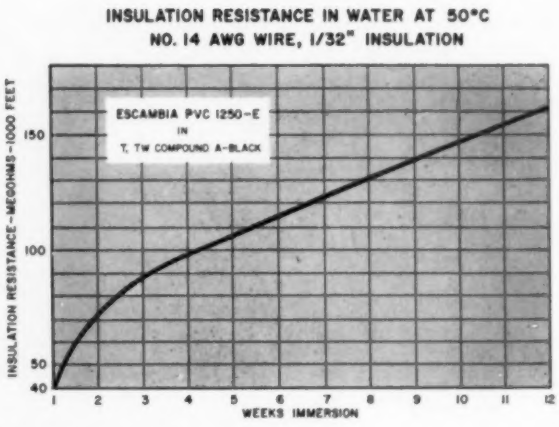

Electrical properties and product quality your customers want and money-saving processing advantages for you—that's what you get with ESCAMBIA PVC 1250-E.

This resin is now on the UL interchangeability list—ready to bring you products that will please your customers and profits that will please you. See for yourself what this resin can do—make a trial run in your plant now.

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NEWS in BRIEF

No plastics recession is foreseen by SPI, based on reports from molders and mold manufacturers. A strong trend toward the use of complex molds for making complicated products in a single operation was reported. In addition, metallizing has enabled plastics to overcome consumer resistance to the non-metallics in such fields as automobiles, business machines, and home appliances in special instances.

Slush molding, a technique usually associated with vinyl plastisols, has been adapted to the processing of polyethylene in a new method developed by Allied Chemical Corp.'s Semet Solvay division. The method involves pouring molten polyethylene into a split mold, allowing it to solidify, pouring off the excess material, and then opening the mold to remove the resulting molded object.

Skin packaging and vacuum-forming equipment of today will possibly require certain advances for the packages of the future, according to D. S. Threlkeld, Clopay director of research (see Guest Editorial, pages 545-6). Operations at higher speeds will require greater automation. The automotive and appliance industries have many spare parts that offer excellent potentials for skin and blister packaging that would rely largely on laminated films having maximum shelf-life and storage stability.

Business developments in the plastics industry were varied in type. Atlas Powder Co. opened its new $3-million technical center in suburban Wilmington, Del. Two new divisions, Plastics and Coal Chemicals, were formed by Allied Chemical Corp. to separate these materials from the roofing, building, and paving materials handled by its Barrett Division. Auburn Plastics, Inc. purchased Norton Laboratories to become one of the largest plastics molding firms in the nation. Durez Plastics division has been decentralized by the parent firm, Hooker Electrochemical Corp., and will operate as an autonomous division of the latter company.

Company expansions in plastics continue to make news. An expansion project valued at over $1-million is scheduled for completion this year by Columbus Plastic Products, Inc. A marine terminal was built by Dow Chemical at Bay City, Mich. Consolidated Molded Products Corp. opened its new injection molding plant in Scranton, Pa. A new unit for the manufacture of PVC emulsions is being built by DuPont at its Toledo, O., plant. Kolker Chemical Corp. plans to erect a phthalic anhydride unit adjacent to its main plant in Newark, N. J. Pittsburgh Plate Glass Co. erected and placed in production a new Selection polyester resin plant at Torrance, Calif. Ridge Printing Co. opened a new plant for laminating, embossing, slitting, and sheeting of plastics in Ridgefield, N. J. Witco Chemical Co. is building a phthalic anhydride plant, scheduled for completion early next year, near its existing facilities in Chicago, Ill.

New Materials of special interest (see pages 577-8): hot-melt adhesive for molded parts; anhydride curing agent for epoxy resins; vinyl type polymerization catalyst; unplasticized melamine-formaldehyde resin solution; series of parallel-fiber glass fabrics; two alkali-dispersible modified alkyds; and polyester foam resin.

New Equipment to be noted (see pages 580-2): redesigned series of automatic compression molding presses; packaged speed variators; precision throttling valves; rotary vacuum-forming machine; recorder-controller for temperature and humidity; constant-temperature drying oven; and hydraulic compression molding press.

Plastics Applications worthy of attention (see pages 583-6): molded alkyd cores for wire-wound resistors; seamless glass-epoxy and glass-melamine resin forms; high heat-resistant phenolic laminates with asbestos reinforcement; glass epoxy fuse holders; automobile oil filter cartridge of butyrate; carving tray of molded high-impact polystyrene; and luminous ceiling formed with rigid vinyl sheets.

An Important Announcement

★ ★ ★ ★

NOW PREMIUM-QUALITY HERCOFLEX® 150 COSTS NO MORE THAN ORDINARY PLASTICIZERS

Long recognized as the quality plasticizer for quality vinyls, Hercoflex 150 (n-octyl n-decyl phthalate) is now available at the new low price of 29½ cents, tanks, delivered (31½ cents West Coast).

This price reduction is a result of a fundamental change in processing, which has opened up greatly increased supplies of the mixed straight-chain alcohols on which Hercoflex 150 is based.

At the new low price, you will find that you can use this premium plasticizer with its higher efficiency where you are now using DIDP, DIOP, DOP, or dibutyl phthalate and show definite cost savings without sacrificing product quality.

If you are not already thoroughly familiar with the properties and performance of Hercoflex 150 in plastics and coatings, write today for technical bulletin and sample. If you have already evaluated Hercoflex 150 at previous price levels, you will probably want to review your findings in the light of the changed economics. In either case, our sales and technical staffs are ready to serve you.

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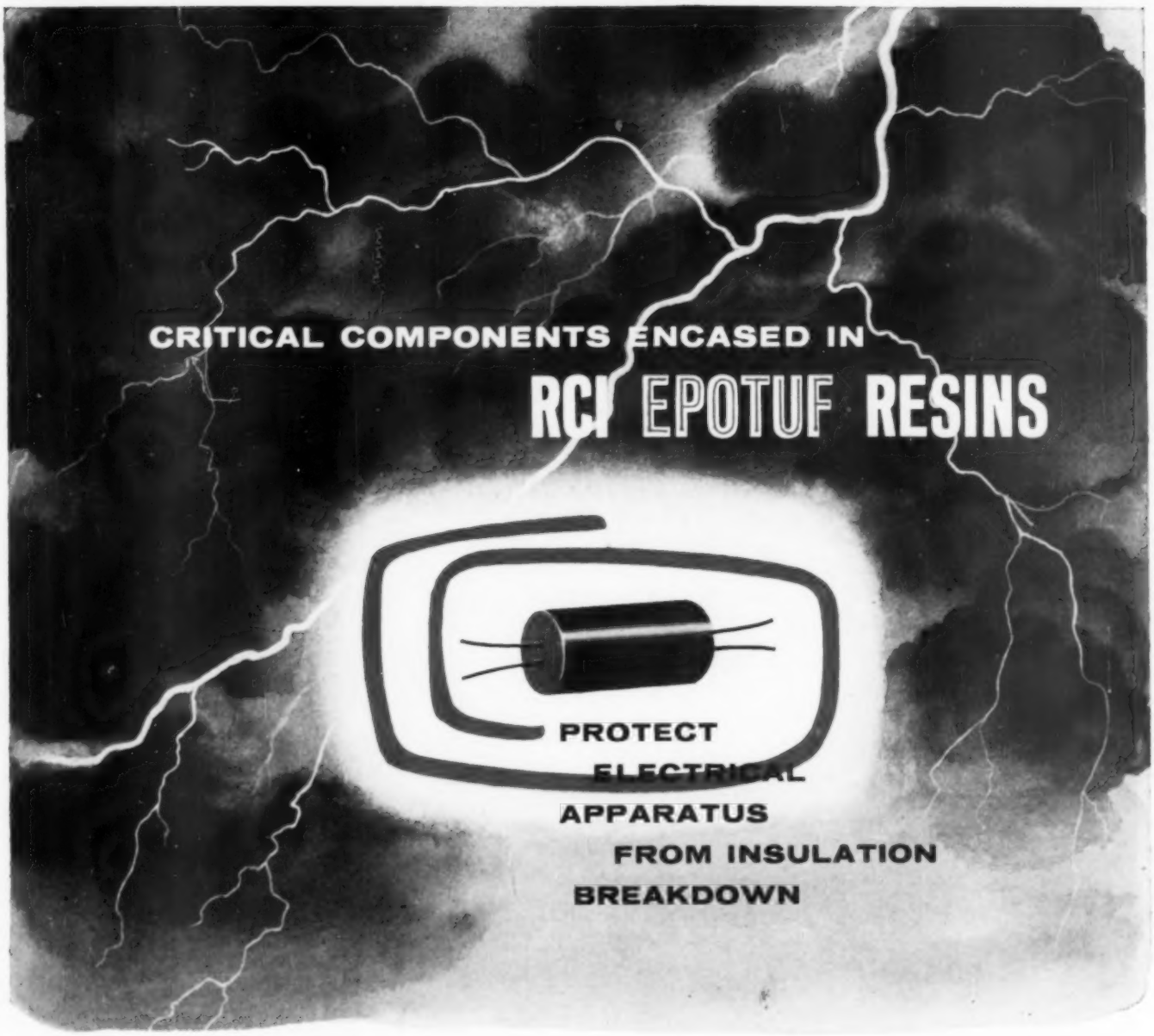

A long, trouble-free life is the forecast for electrical parts protected with RCI EPOTUF epoxy resins. Insulation made with these resins and appropriate hardeners is tough enough to surpass the most rigorous electrical and mechanical demands. Room temperature curing means no heat of reaction to harm delicate components.

Elements encapsulated, embedded or potted in EPOTUF epoxy resins are virtually free of failure, thus minimizing the need for costly maintenance and increasing the overall efficiency and reliability of the complete unit.

EPOTUF resins harden with outstanding adhesion to metals, glass, ceramics and other materials. They offer high mechanical strength and superior dielectric properties. The liquid nature of these resins permits penetration of fine crevices, and their low shrinkage assures highest dimensional stability.

If these numerous advantages of durable, dependable, corrosion-resistant EPOTUF epoxy resins fit your application, get in touch with RCI.

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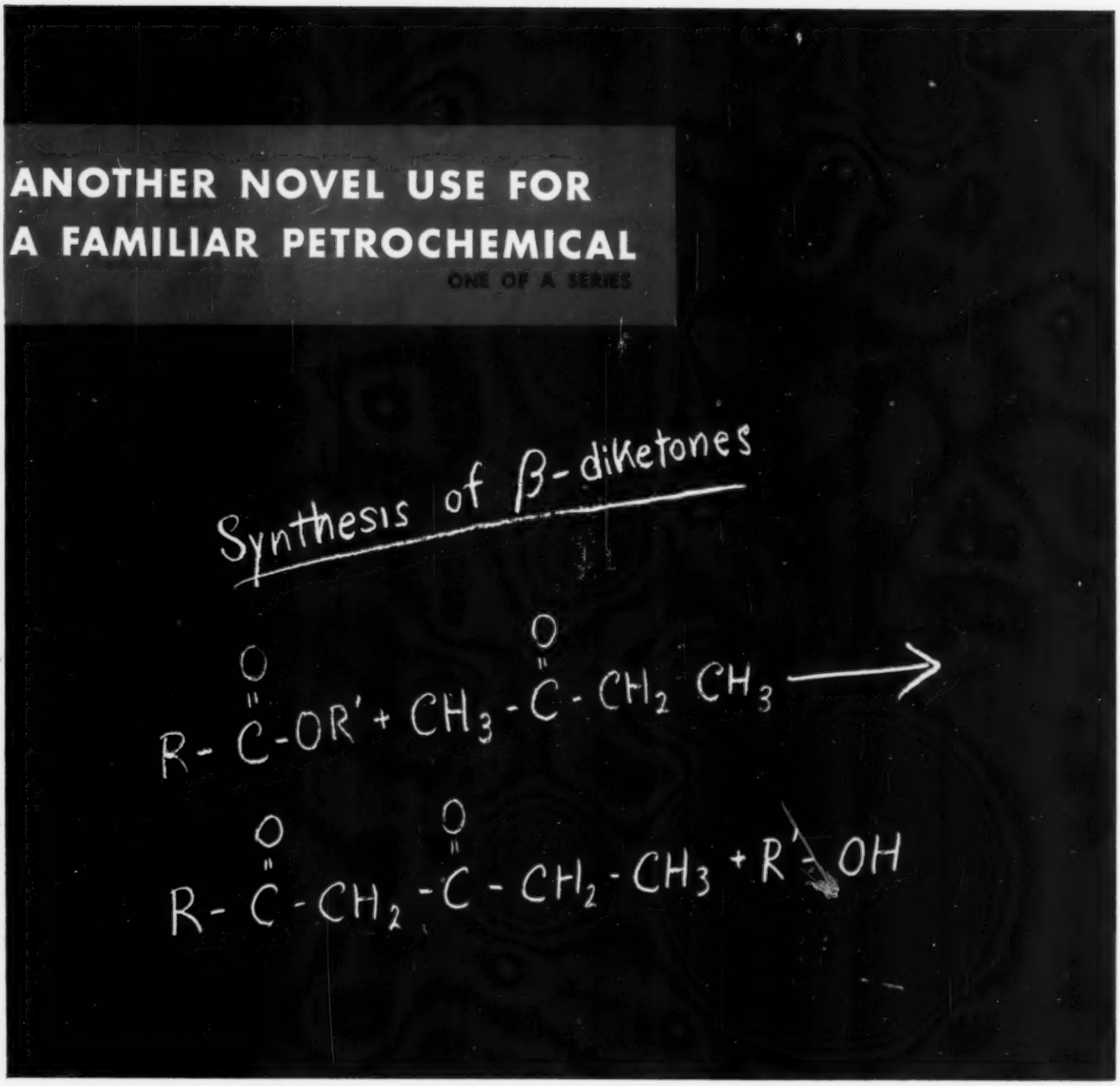

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- Light color
- Superior to Santicizer 630 in volatility, low temperature flex and tolerance for secondary plasticizers

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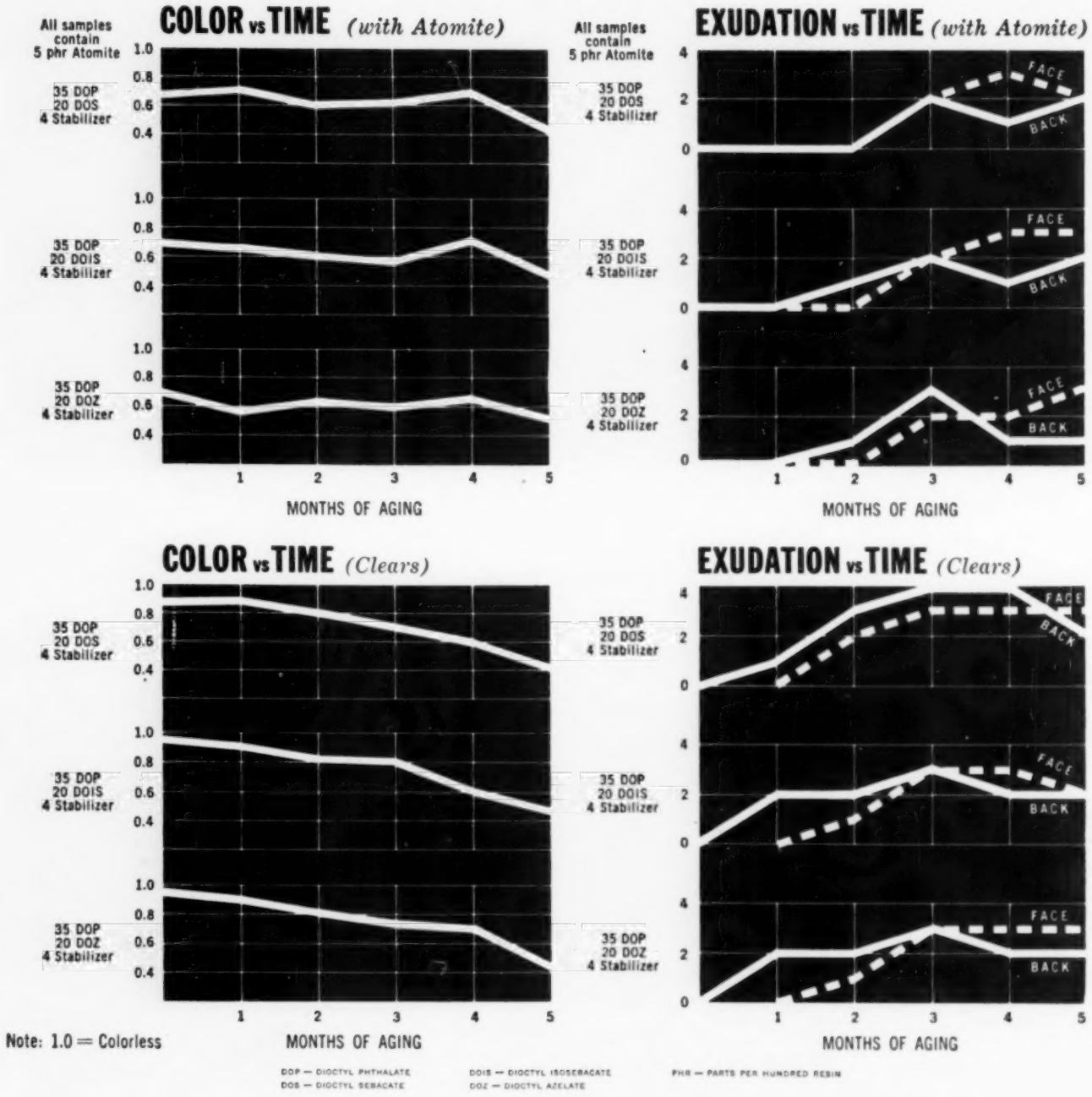

Florida aging tests show ester of **ISOSEBACIC® ACID** matches performance of other vinyl plasticizers ...and it is more economical

The dioctyl ester of ISOSEBACIC® acid matches the performance of more costly dioctyl sebacate and azelate as a plasticizer for vinyl resins. The evidence is provided by the above charts of a recent, independently conducted test.*

ISOSEBACIC acid is a new synthetic intermediate made by U.S.I. A mixture of three C-10 dibasic acids —2-ethyl suberic, 2, 5-diethyl adipic, and sebacic acids— it offers a number of interesting properties. Other uses include— intermediate for polyamides, polyesters, polyurethanes and alkyd resins.

ISOSEBACIC acid soon will be available in commercial quantities from U.S.I. at Tuscola, Ill. Price comparisons with competitive intermediates indicate that ISOSEBACIC acid will afford important savings.

This might be a good time to evaluate ISOSEBACIC acid for your operations. Send for data sheets and samples.

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World's largest producers of fiber glass reinforced plastic products adopt ISOPHTHALIC based RESINS

Mr. R. S. Morrison, president of Molded Fiber Glass Body Company, has this to say about new ISOPHTHALIC based polyester resins used in their complete line of '58 "MFG" boats.

"Tests made by the Molded Fiber Glass Research Co. proved that an Isophthalic-type polyester resin gave us both increased toughness and increased craze resistance at all normal temperatures. The superior physical properties obtained far offset any cost differential. We have also adopted Isophthalic-type polyester resin in all our automotive applications."

Fast, tough "MFG" 15-footer with revolutionary hull design. Extremely strong and impact resistant.

Frisky 12½ foot "MFG" Corry featuring the famous tough MOLDED FIBER GLASS hull with exclusive lapstreak design.

An Isophthalic-type polyester resin used in the complete '58 "MFG" line offers the dealer and boating public longer-lasting boats that require virtually no maintenance. The new Isophthalic based resin used in their construction provides greater laminate strength plus greater resistance to flexural fatigue.

Isophthalic is a basic new raw material produced by the Oronite Chemical Company. For information regarding its properties and applications, contact the Oronite office nearest you.

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PLASTICS
TECHNOLOGY

Mold Design for High-Density Polyethylene

The importance of sprue, runner and gate designs; molding temperature control; rapid mold filling; and pre-compressed molding is stressed.

ALBERT SPAAK, *Applied Arts Supvsr., Tech. Service Lab., Polymer Chemicals Div., W. R. Grace & Co., Clifton, N. J.*

As is true with all plastic materials close adherence of fundamental plastic engineering principles must be used in order to obtain the best economical cycles, physical properties, surface finish, and dimensional stability of high-density polyethylene molded parts. Proper part and mold design, careful selection of molding machine equipment, and development of good operating specifications all are prerequisites in order to turn out a quality product at an economical production rate.

This new resin has distinctive characteristics, including a sharp melting point, and a high viscosity over a wide temperature range. Bearing in mind the specific properties of the material, the molder should modify his techniques accordingly in order to achieve satisfactory moldings. The design of the mold and selection of molding machine must be made with the aim of achieving maximum polymer flow with high cubical displacement of plastic material into the cavity.

One of the chief concerns today in the tooling for high-density polyethylene plastic resins in the industry is the problem of shrinkage and warpage of the plastic part after it is molded. Mold designers and product designers should be geared to cope with these problems and minimize the possibility of excessive warpage and shrinkage. From past experience with other resins, the designer should consider carefully the proper type of gating, the location and design of mold cooling channels, and the choice of proper mold building materials. Careful design of the mold, plus accurate control of the molding conditions, usually will produce a high-quality molded part.

Generally speaking, most of the conventional-type polyethylene resins have a large degree of amorphous regions between the crystals when compared with high-density polyethylene. Therefore, the strains introduced by variations in mold temperature and injection pressure in filling the mold are absorbed within the molded part without physically changing outward appearance.

High-density polyethylene is a linear-type polymer material that has between 80-90% crystallinity, as compared with 50-60% crystallinity of conventional-type

Based on a paper presented at the National Technical Conference, Society of Plastics Engineers, Inc., Detroit, Mich., Jan. 29, 1958.

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polyethylene. Consequently, we do not have as much amorphous regions between each crystal and when we force this material into a mold either under adverse conditions or without proper mold cooling design, the resultant orientation of the crystals due to the injection pressure applied has a tendency to orient with introduced molding strain, thus causing a certain amount of distortion.

The highly crystalline molecular structure of this material gives high-density polyethylene its unique properties, such as high tensile strength, greater stiffness, better barrier properties, high heat resistance and greater hardness. In order to mold high-quality complicated structural parts, therefore, we must design molds adequately so that we can cope with these inherent properties of the resin.

From a practical stand-point, we might say that many of the techniques in molding zinc and aluminum die castings are related in some degree to the techniques for molding this high-density polymer. There is a need for proper design of sprues, runners and gates, and mold-temperature control units are a valuable tool. High-speed injection (high rate of cubical displacement of the material in the cavity) is necessary in order to avoid crystallization of the polymer during the cavity-filling time.

This paper covers ways and means of designing molds incorporating these three important variables, namely: (1). Sprue, runner, and gate designs; (2). Mold temperature control; and (3). High cubical displacement of plastic material into the cavity.

Sprue, Runner and Gate Designs

This material, having a high viscosity in the plastic state, usually requires generous runners and larger gate sizes than commonly are used for conventional polyethylene. All multi-cavity molds should be designed with the shortest possible runners and having gates balanced for a uniform fill of each cavity. Primary runners should be extended beyond the farthest secondary runner to act as cold slug wells ahead of the cavity.

It is preferable to use a balanced runner system in the majority of cases. Large, short sprue bushings should be used wherever possible, and runners should be ¼-⅜ inch in diameter and preferably round in order to insure a good flow of hot material directly into the cavity. Roughened runners are desirable, since the material then rides on the high spots and the degree of contact with the runner wall is less, and the material retains its heat better.

A cold slug well at the sprue should be provided wherever possible. It should be sufficiently deep to accommodate a large nozzle slug. Sprue-gated or center-gated parts that cannot take a cold slug often will show blemish spots around the product opposite the gate. In such cases, it is very helpful to use a reverse taper-type nozzle and to keep the nozzle at a maximum heat of operation to avoid freezing of the polymer in the nozzle between shots.

Multi-gating a large part often is desirable to obtain rapid fill at low material temperatures and pressures and, also, to minimize the distance of flow from the point of gating. All gates on the multi-gated part should be balanced to obtain uniform fill, with the final weld taking place at the far end of the part.

A multi-gated part should be so gated that the material will reach a complete shot at about the same time in all parts of the cavity to be filled. The part should be so designed or gated that the plastic flow will allow entrapped air to escape from the mold and not cause gas burning pockets and welds.

Figure 1 shows a six-cavity molding that is unbalanced and poorly gated. The two center cavities are the first to fill, thus exerting a higher pressure in these cavities than necessary in order to fill the four end cavities. The runners are too small without adequate cold slug wells; therefore, the chilled material enters the cavity first, causing jetting and surface flow marks.

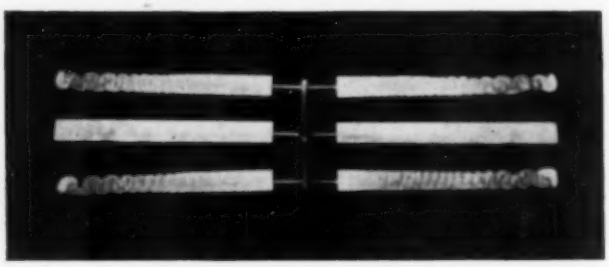


Fig. 1. Unbalanced and poorly gated six-cavity molding.

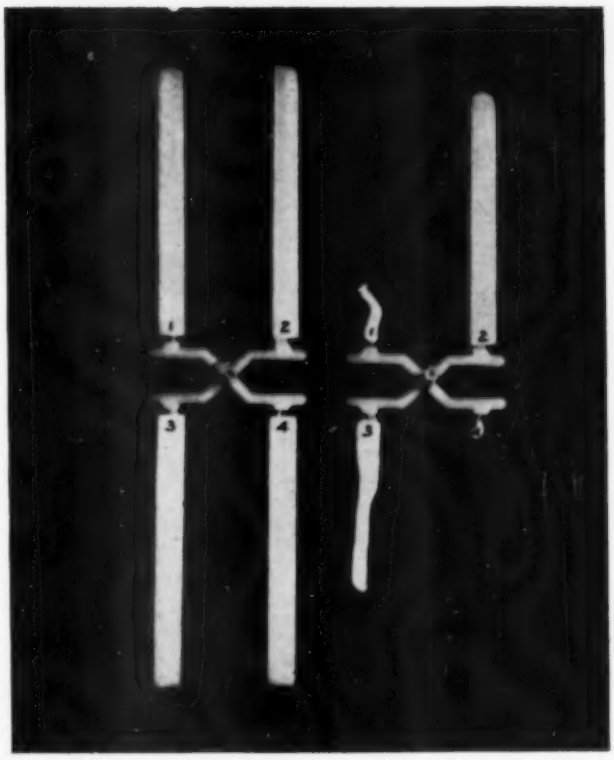


Fig. 2. Four-cavity impact bar moldings with (left) balanced gate design and thick runners, good cold well, and short lands; and (right) pin-point gates.

Figure 2 illustrates a four-cavity impact bar molding that has a well-balanced gate design with generous runners, a good cold well, and short land distances between the runner cold well and the piece proper. In Cavity #1, we have a 0.030-inch diameter converging pin-point type of gate. It can be noted that jetting from the short shot occurs in this particular cavity indicating, therefore, that pin-point gating cannot be directed from the end of the cavity, but must be directed against a cavity wall or core pin. This also causes flow lines on the surface of the finished impact bar. The gate on Cavity #4 is similar to that on #1, but is smaller in diameter and indicates less flow of polymer into the cavity.

The gate on Cavity #3 is an approach to proper gating for this part, but still is too small to provide for a quality molded impact bar. For an impact bar ¼ x ½-inch in size, it is necessary to have a good size gate, as indicated in gate #2 (which is ¼-inch wide by $\frac{1}{16}$-inch deep), needed to obtain a good, full piece. Here, we do not have any indication of surface flow lines, since the cavity is being filled gradually with a full-mass front, without any jetting.

Molding Temperature Control

It now has become apparent that the molder can no longer ignore mold temperature control. The mold designer should give prime consideration to the channeling of a mold directly after the cavity is layed-out in the mold base. Too many water cooling channels cannot be put into a mold. Their position should be studied so as to give as uniform a heat transfer as it is possible to obtain. In most cases, it has been found necessary to keep the area in the mold nearest the gate or sprue as cold as possible, and to gradually increase the temperature of both the cavity and core moving away from the sprue area.

The above greatly helps the flow of high-viscosity polymer and decreases injection-molding cycle time. A uniform mold surface temperature should be maintained and, if possible, a slight increase in mold surface temperature away from the gated area. Since the material is chilling down rapidly, a slight increase in temperature will prevent the material from chilling down too rapidly. A controlled mold temperature in the 100-150° F. range generally is recommended. If the finish is not the prime consideration, however, colder molds can be employed to decrease the molding cycle time.

In some cases, higher mold temperatures are necessary to give the required finish and polymer flow to fill the molded item. Again, wherever possible, it is recommended that mold temperature control units be employed when molding high-density polyethylene.

Figure 3 shows a 13-inch diameter shallow dish test mold. This mold was cooled in a conventional manner by running a series of longitudinal channels horizontally through the mold. The water entered the bottom section of the mold in one opening and zig-zagged through the horizontal channels to come out at the top opening. During the molding cycle, readings were taken on the mold-cavity surface. Temperatures of

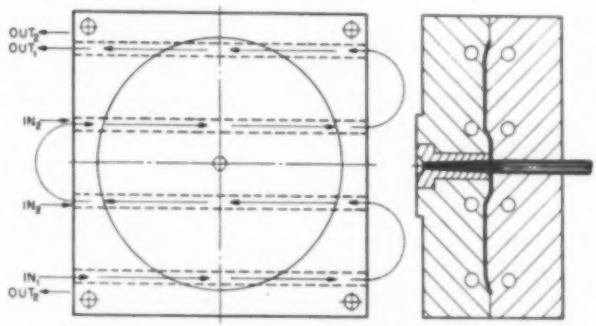
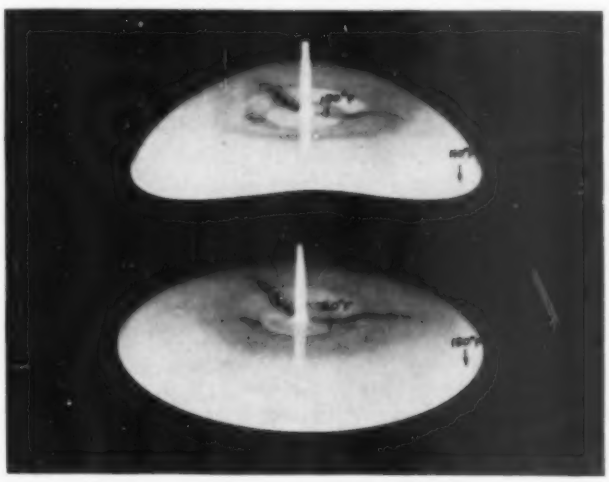


Fig. 3. Shallow dish test mold with horizontal channel cooling.



Figs. 3A, 3B: Upper illustration (3A), dish molded with horizontal channel cooling shows extreme warpage; lower, (3B) dish molded with checkerboard cooling is free from warpage.

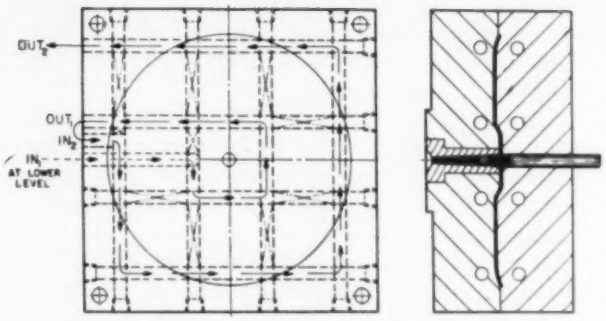


Fig. 4. Shallow dish test mold with checkerboard cooling.

150° F. near the sprue area and down to 110° F. at the very end of the cavity were indicated. It can be seen from the upper illustration Figure 3A that extreme warpage occurred in this part. One way to help the condition of warpage and the high temperature near the sprue area is to run two cold water lines through the two water holes near the sprue, and then come out with one water line at the top outlet. However, this is an improvement to the first cooling circuitry and, in some cases, will be sufficient, but does not give complete uniformity and mold temperatures.

Figure 4 is a lay-out of this mold where holes were drilled directly opposite the longitudinally-drilled holes, so that a checkerboard pattern was obtained. Some of the water holes were plugged to obtain two separate circulations. A series of plugs in certain sections of the channeling were placed in the holes so that we were able to introduce our coldest water by drilling beneath the layer of crisscross holes and coming out near the sprue area with the water, then making a complete rectangular arrangement and bringing this water out to the side of the mold.

This water then could be introduced into the second rectangular arrangement before being returned to the mold temperature control unit. If the part is very thin and critical insofar as warpage is concerned, controlled water at a different temperature could be introduced in the second rectangular arrangement that, in essence, would give a higher mold temperature away from the sprue area. By this construction involving a small amount of alteration to your present mold, it is possible to mold high-density polyethylene without an appreciable amount of warpage. Figure 4A shows the same shallow dish (as in Figure 3A) that is free from warpage and was autoclaved at 250° F.

Figure 5 illustrates a spiral cooling-type of construction that can be used on current molds that have drilled holes throughout the cavity and core. In this approach, a spiral groove machine is shown on the back of both the cavity and core section and, since it would cut into many of the drilled holes present in the mold, it would be necessary to insert copper tubing in the spiral groove. In order to have good heat transfer from the copper tubing to the mold, it would be helpful to pour lead or white metal around the copper tubing.

Another approach to spiral cooling design is shown in Figure 6. The cavity and core base plates are made in two parts. The spiral groove is machined into one side of the plate, and the two plates are hydrogen-

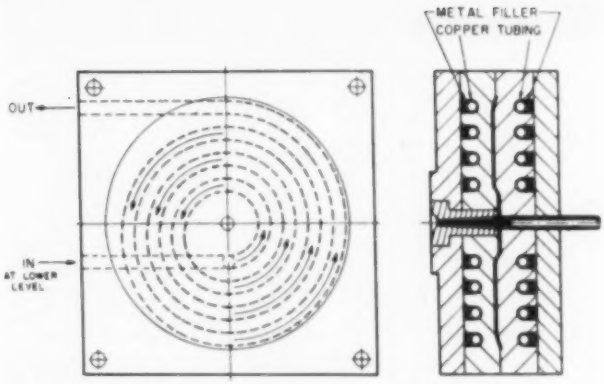


Fig. 5. Mold with spiral tube cooling channels.

brazed together in order to obtain a good seal and, also, to eliminate leakage resulting from the compressibility of the mold in usage (that would occur if a gasket were employed).

Labyrinth type of cooling using O-rings on sealed, turned and milled grooves for ease of fabrication is shown in Figure 7. Since high-density polyethylene has a high specific heat, it is necessary to supply sufficient channeling in the mold to obtain the greatest speed of heat transfer at a uniform rate in order to obtain a plastic state.

In the case of high-temperature spots around the sprue area or about heavy sections, a higher heat-transfer rate can be obtained by using beryllium-copper or forged aluminum inserts. These will remove the high surface heat in the cavity. This also would be in line with the old foundry practice used when casting iron or steel with large section changes; they use iron chills at the heavy sections to draw out the heat faster, thus avoiding sinks or blows in the casting.

There is no doubt that obtaining uniform heat transfer throughout the entire mold is a difficult problem and one that is found rarely in any mold. We have found that high-density polyethylene is rather susceptible to variations in mold temperature changes. Every effort should be made to keep the variation in mold surface temperature at a minimum.

High Cubical Displacement

Many articles and papers have been written and published about the ability of high-speed injection to cubically displace plastic material in the mold at a faster rate. With high-density polyethylene, which has a sharp crystallinity temperature, it is important to fill the mold as quickly as possible, especially when molding thin sections. This will be of definite assistance in molding thin, deep-draw sections, and in obtaining a more uniform cooling rate throughout the mold. In making larger items having relatively thin walls, the problem of cavity filling becomes more critical. There is no doubt that better flow of the polymer is required, and one way to obtain this is to increase the speed of injection.

We have noticed that items molded in high-density polyethylene on preplasticizing machines prove to be of higher quality with less amount of warpage and shrinkage than parts made on conventional injection molding machines. In the case of a preplasticizer,

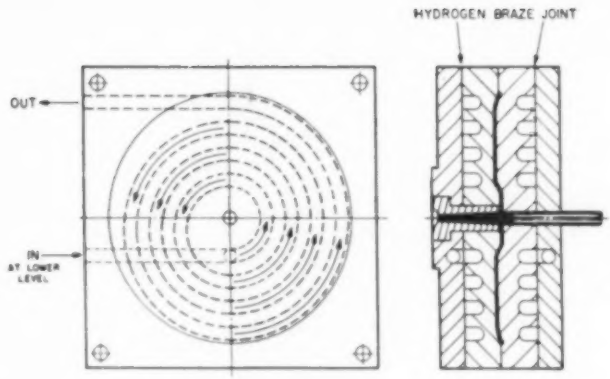


Fig. 6. Mold with spiral milled cooling channels.

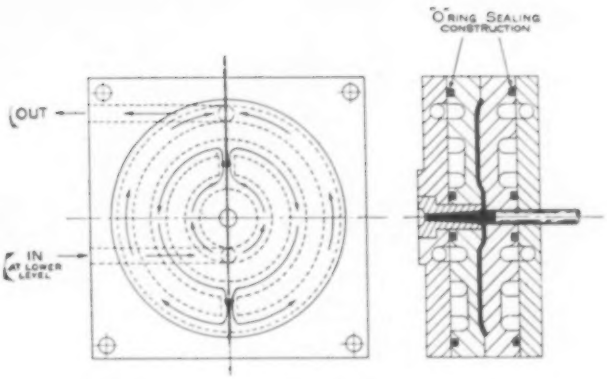


Fig. 7. Mold with labyrinth-type cooling grooves.

homogenized material is forced by an injection ram directly through the nozzle, without first compressing the pellets to be melted in a heating chamber. In essence, higher rates of cubical displacement into the cavity are being obtained.

The ratio of preplasticizing machines on the market is quite small when compared to conventional injection machines. Therefore a means of obtaining higher rates of cubical displacement of plastic material in conventional machines must be found. When extra motors and added pump capacity are adapted to conventional machines, the injection speed will be increased proportionately.

Pre-Compressed Molding

We believe that items heretofore impossible to mold in high-density polyethylene can be molded at practical economical cycles in special molds incorporating the multiple valve gate technique. This does not mean, however, that high-density polyethylene cannot be molded by conventional means.

It is well known that most plastic materials are compressible. This is particularly true with high-density polyethylenes that can be compressed in the molten state within the heating chamber and hot runner system. If this material first could be compressed within the heating chamber to build up a residual pressure, and then released into the mold, the actual filling time for the plastic material in the mold could be reduced. This would give us a high rate of cubical displacement.

The industry is talking presently about hot runner mold designs that could be used for automatic molding, thus eliminating the need for any sprues or gates. We also have heard much discussion about nozzle pressure-sensing devices. When all of these various designing techniques are combined, the result is the mold design illustrated schematically in Figure 8. This particular valve gating design is a patented design assigned to Columbus Plastic Products, Inc. It has been used successfully by this company for the past several years. We have proven that it lends itself quite readily for use with high-density polyethylene, and it now is available to the industry under licensing arrangements.

In this particular schematic drawing (Figure 8), the gate valves close as the injection takes place, thus compressing the mass of material in the heating chamber to a given pressure. As the material pressure builds up, it is indicated by a pressure-sensing device at the nozzle, or could be controlled by a timing mechanism or a pressure switch on the hydraulic oil circuit from the start of the injection forward-control mechanism. When a certain pressure is reached or a certain time has elapsed, a relay operates a mechanical device such as an air- or oil-operated cylinder that, in turn, opens the gate valves and allows the plastic material to rush in at high velocity and high pressure.

Therefore, we are accomplishing what is required with this highly crystalline material; very rapid filling of hot material into a mold. When the cavity is filled completely, the injection piston can be returned and, through the same sequence of operating by either the pressure-sensing device at the nozzle or through some electrical arrangement, the valves will close and the part be ejected without using any sprues, gates, or special hot runner-type nozzles that require very accurate control of plastic material temperature.

Valve gating permits the molding of larger, deeper, and greater area shots with considerably smaller machines than if conventional gating were used, primarily because it allows efficient multiple gating of the piece, thereby reducing distance of flow and the need for excessive pressure and temperature. In some cases, valve gating will make it possible to mold pieces that could not be molded normally, regardless of press size. In almost all instances, valve gating using any materials in any machine reduces the length of the molding cycle.

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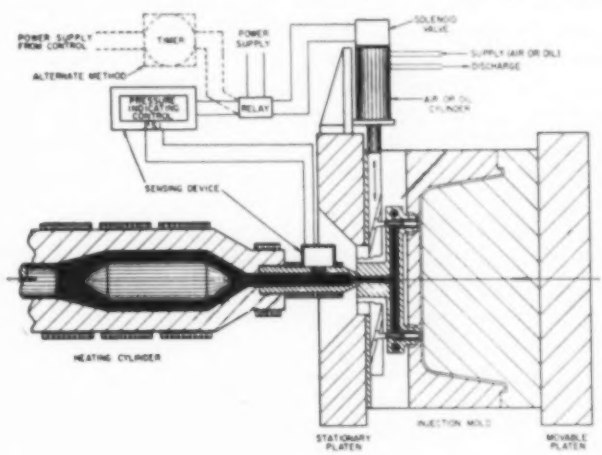

Fig. 8. Schematic view of hot-runner, multi-valve gate mold.

Dielectric Heat–Sealability of Films

An apparatus is described that is being used in a systematic study of heat-sealing parameters for use in product control and development.

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IN the heat-sealing of plastic films by radio-frequency techniques, there are two categories of problems. Firstly, there are material or product variables. One material may be formulated or compounded so that it is distinctly more difficult to seal than a similar material in the same general group. For example, the colorant, the lubricant, the plasticizer, and/or other additives in a formulation may adversely affect the sealability.

The second group of problems generally is attributable to machine or environment variables. For example, a thin coating of oil caused by handling of the plastic film, or a poor surface due to dust and dirt may disturb the seal. In addition, radio frequency maching setting produces many variables that can result in poor control of the sealing. Commercial machines have been found highly inefficient; they provide coarse control of the seal power, and do not stabilize the frequency used for the seal.

An apparatus that might properly be called a precision R. F. sealer has been developed. All significant parameters are or can be controlled. The power absorbed by, as well as the voltage across the seal, can be measured accurately. By employing this apparatus, film sealing can be studied and many of the variables traced and defined.

Apparatus

The sealer proper consists of the electrode structure used in a commercial machine; a rotating electrode designed for continuous film sealing. The electrode pressure is adjustable, and electrode penetration into the material is fixed by two Teflon idler bushings on each side of the electrode. A variable speed drive was installed to give material speeds continuously variable from 0-1.5 feet per minute. This slow speed is advisable because tuning adjustments have to be made while the material feeds through the machine. The understruc-

ture of the machine contains a tuning and matching network, as well as an R. F. vacuum tube voltmeter probe. All R. F. power is fed to the machine through a 50-ohm coaxial cable from a separate R. F. console.

The line that feeds the sealer incorporates a bidirectional coupler. Actually, this coupler consists of two units: a commercial coupler for absolute or reference levels; and a modified coupler to provide power-absorbed information. Either coupler may be used, but the combination is most flexible. A directional coupler is a device that senses the incident power sent to the sealer and, by turning a switch, measures the reflected power. Both positions have ranges of 10, 100, and 1,000 watts full scale.

The difference between the incident and reflected powers is a measure of the power absorbed in the seal and matching network. This difference is computed directly by the second unit which actually senses the absorbed power. It is obvious that these directional couplers can be used in the tuning-up procedure, because the reflected power will be a minimum for any incident power level if a dielectric sealer is operating efficiently and properly. As mentioned previously, an R. F. volt-meter measures the voltage across the seal.

This extra bit of information is of lesser importance than the power level measurements. The sealing voltage reaches a maximum when the reflected power is at a minimum and, therefore, can be used as a tuning indication. As will be indicated later, the voltage across the seal reaches a plateau at the formation of a seal. Voltage measurements are taken for the sake of achieving completeness of data. Thus far, these measurements have not been found to be very significant.

The R. F. generator is a 200-watt, crystal-controlled power source. The operating frequency can be set by selecting the proper crystal and tuning the following power stages. A frequency of 27 megacycles was selected as typical for film sealing and standardized. Frequency control is considered essential to the apparatus, since it is known that the dielectric properties of plastics change with frequency. Similarly, every tuned network in the apparatus is vulnerable to frequency changes; a frequency change of 1% can result in significant sealing difficulties unless the circuits are returned. By crystal controlling the frequency, another significant variable is controlled. A driver circuit feeds into a buffer amplifier that, in turn, drives the push-pull final. The output has an adjustable power supply that can control the final power output continuously from 0-200 watts. Actually, a small fraction of this available power is ever used in a seal. A block diagram of the sealer is shown in Figure 1.

Electrical Characteristics of a Seal

Theoretically, it would be desirable to use the apparatus as an adjustable power source; i.e., increase the power level until the seal is considered satisfactory, and take that power level as the minimum power required for a seal. Match conditions would be noncritical, since the absorbed power always could be determined. This test procedure requires continuous evaluation of the seal. In many cases, seals are difficult to evaluate until the weld is torn apart. As the power

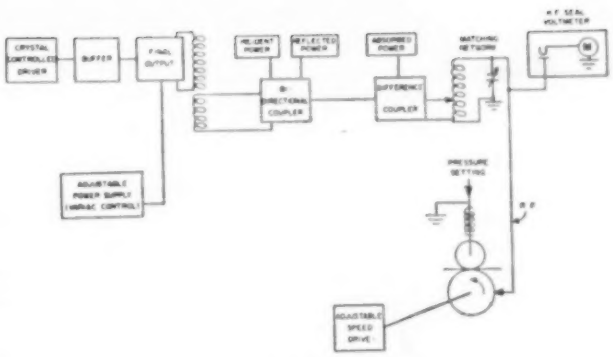

Fig. 1. Block diagram of heat-sealability test apparatus.

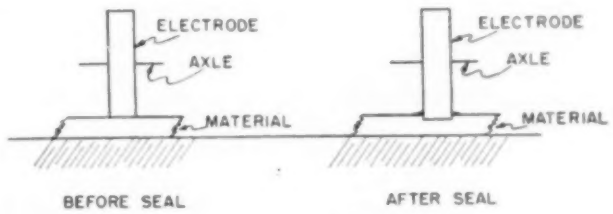

Fig. 2. Deformation of the material during seal formation increases the consumption of watts per unit volume.

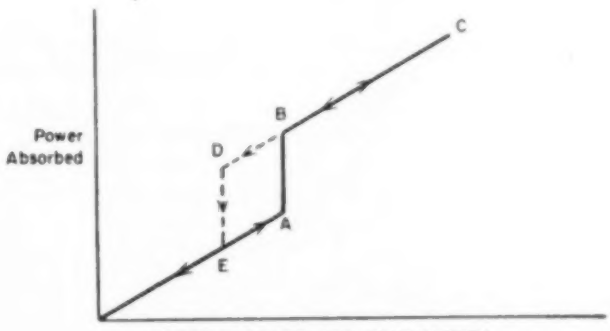

Fig. 3. Effect of incident power on absorbed power during sealing.

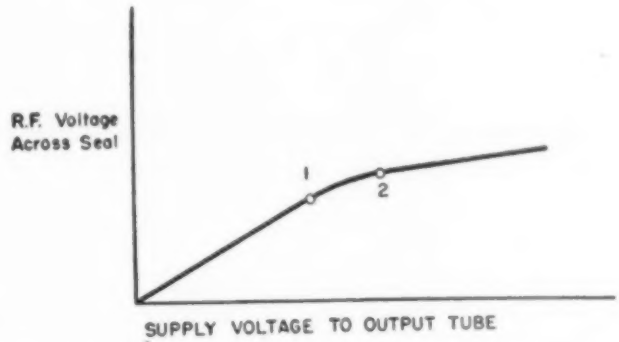

Fig. 4. Effect of voltage supply on R. F. voltage across seal.

increases, the material softens, then flows into the sealing phase; if the power is increased further, there is a possibility of burn-through and, therefore, the seal-point would not be distinct. For this to occur, the heat sealer must be matched so poorly that the seal does not reflect to the generator.

Consider the electrical characteristics of a seal as it is formed. When cold, the losses are moderate, and the material is sufficiently strong to support the electrode. As R. F. power is dissipated in the seal, the temperature rises and, for most materials, the dielectric losses increase. The increased losses enhance the power dissipation, causing the temperature to increase even more. As the temperature increases, the material deforms, causing the volume under the electrode to decrease or the watts/unit volume to increase (see Figure 2). Ignoring dielectric-constant changes, it would appear that a certain R. F. power put into the seal, the temperature increase, the deformation, and the increased loss factor complement one another and cause the absorbed power to rise sharply. At this point, the seal is truly formed in that the material is hot and flowing.

To complicate the matter, however, the power match conditions when a seal is formed are different than the pre-seal conditions. This effect can be used advantageously to define the point where this power-grabbing or avalanche takes place. Consider the apparatus adjusted so that the circuits are tuned for optimum power transfer or match when sealing. The power (incident) is returned to zero level. As the power is increased, a sudden jump is observed in the absorbed power at "A" (see Figure 3). This jump takes a finite time during which the material deforms, increasing the watts/unit volume which, in turn, increases the temperature which increases the losses, and so forth, until the seal is formed at "B". The power match likewise is improving in the transition from "A" to "B". Increasing the applied power to "C" forms a heavier seal. If the curve is retraced, then the material will seal down to point "D" perhaps due to the reduced "bite" or the higher temperature of the rolling electrode. After "D", another jump down to the no-seal condition is observed.

This pattern can be observed regularly with good reproducibility. In all cases, "B" correspond to sealing conditions, and "A" appears to be indicative of the minimum sealing level. Although "B" is said to correspond to sealing conditions, we occasionally find materials that flow, deform, and get hot, but yield a seal of no strength. These materials cannot be classified properly by this technique.

This jump phenomenon can be extended to explain why, in certain cases, no seal is formed and a slight increase in power causes burn-through. Materials that decrease their losses with increasing temperature, and materials that are difficult to deform would not exhibit this jump phenomenon and also probably would be difficult to seal. Unless otherwise specified, the power levels at "A" and "B" are used as points of comparison in all tests described.

If the voltage across the seal is examined, a curve typical of Figure 4 is obtained. In the region 1-2, the seal is formed and there is a reaction on the R. F. source which tends to limit the seal voltage. There is no distinct voltage, however, that can be defined as the sealing voltage.

Test Results

The power developed in a seal appears to be the sole important factor in the formation of that seal, and is the power that heats the material and causes it to fuse.

There appear to be two general areas in which the apparatus can be employed for absolute measurement or for comparison studies. Assuming that the power jump previously described is a reliable index, this point can be used in comparing materials and variables. Thus, at a certain speed, thickness, and electrode pressure, the material that has the power jump take place at a lower level is easier to seal. As the second application, the same power (greater than the jump level) can be sent into two materials and form two seals. These seals then can be tested physically for strength by established procedures, and the stronger seal specifies the better of the two materials.

Some results obtained in exploring the possibilities of the apparatus are presented in Table 1. Four samples of film were prepared. Material "B" was a clear, standard, control formulation. Material "D" essentially was the same with 15% of titanium dioxide added. Material "E" was the same as "B" with 3% of blue pigment

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Table I. Results of Heat-Sealability Tests.

Sample	P_A	P_B	Remarks
B	13.1	15.0	Good seal.
D	16.2	19.7	" "
E	8.9	11.4	Deforms, but poor seal until about 16.
F	8.9	11.3	Deforms, but poor seal until about 15.

Table 2. Effect of Film Speed on Heat-Sealability

Film Speed, Ft./Min.	P_A	P_B
0.2	10.2	12.9
0.4	9.8	12.4
0.6	12.1	15.6
0.8	11.1	14.3
1.0	16.0	20.2

Table 3. Effect of Film Plies on Heat-Sealability

No. of Thicknesses	P_A	P_B
2	13.6	16.7
4	10.1	16.5
6	13.6	27.0
8	9.7	15.9

PLASTICS
TECHNOLOGY

Guest Editorial

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Innovations Through Skin and Blister Packaging

WE are living in an era of great innovations brought about by the efforts of many people from research, development, sales, management, engineering, and production. Many things considered commonplace today were due to innovations in the past.

Counter-displayed merchandise was non-existent in stores in the latter quarter of the nineteenth century. Dry goods were on shelves behind counters and small-merchandise items were kept under counters and in drawers behind the counters. The idea of counter-displaying merchandise for customer viewing and handling has been credited to the founder of the F. W. Woolworth stores. Today we expect to see merchandise displayed on counters or in showcases whether we visit the grocer, the butcher, the baker, the drug store, or even the variety store and department store.

In the era around 1930, other innovations appeared. One of these was cellophane, a new, clear, wrapping material for packaging. Another was card merchandising. Whether you wanted a safety razor, a box of aspirin, a bottle of nose drops, or a pocket knife, you could find it displayed on a card on the counter of the nearest store. It also may have been wrapped in cellophane.

Both of these features have made their contributions to today's merchandising methods and techniques.

In the years since the introduction of counter displaying of merchandise, many new materials have been developed, some contributing to enhancement of merchandise by means of packaging. With the introduction of each new plastic resin or film, there came new methods of packaging. A few years ago, a vacuum-forming machine was introduced and permitted a plastic film or sheeting to be heated and drawn over a mold or an object in such a way that the plastic draped or formed to the countour of the mold or object. This innovation grew in use and acceptance. With or without modification, it can be used in methods of packaging called skin, blister, and contour packaging. Several vacuum-forming machines have been developed for use in such packaging, and are capable of packaging items up to six inches in height with films as thin as 0.001 inch and sheeting up to ⅛-inch in thickness.

This type of packaging is an electronic age answer to the five-cent store counter displays of the nineteenth century. It gives the consumer the opportunity to see, handle, and investigate the packaged item

with no opportunity of it being soiled or damaged. Many stores will use one item unpackaged for a demonstrator, and the customer may handle this item to determine if it conforms to his desires before his purchase. Today, we can see these visual packed items in such commodities as foods, toiletries, toys, cosmetics, and drugs (even to individually-packaged pills). It has been stated that one of the largest potental fields for this type of packaging could be that of hardware items.

Briefly explained, skin packaging is the formation of a plastic skin around the object to be packaged. This requires a chip board or card that has been printed with any directions or sales promotion ideas, and, in some cases, colored to attract a potential buyer's attention. After the card or paperboard stock has been printed, the printed surface is treated with a material that will promote adhesion of the card to the skin-forming plastic film. Such materials as pyroxylin, polyvinyl acetate, and vinyl solutions have been used successfully to promote adhesion of the forming film to the board. However, it is most desirable to consult an adhesives engineer to obtain the board materal best suited to the product to be packaged, as well as one that is most compatible with the film of your choice. An important point in blister and skin packaging is moisture in the board stock. The board should be dry and free from moisture to give good bonding characteristics. Either prior to printing or after coating, the card is perforated with a number of small holes to permit the plastic film to be drawn down on it when the vacuum is applied in the forming operation.

The films available include extruded (flexible), cast, and rigid vinyls; cellulose acetate; linear polyethylene; cellulose acetate butyrate; polypropylene; acrylic; nylon; high-impact styrene and polyester types. All of these could be candidates for your skin-packaging application, but the following questions should be considered:

(1). Is the packaged object heavy or light?

(2). Would the shelf life generally be long or short?

(3). Would high abrasion resistance be required?

(4). Is resistance to either low or high temperatures required?

In skin packaging, the items to be packaged must be unaffected by the temperature necessary to drape the film, and strong enough to withstand the required vacuum pressure.

One of the major disadvantages of cellulose acetate film is its shrinkage on aging, causing the board to bow or curve. It would appear that vinyl films would be much better on heavy hardware items than either cellulose acetate or cellulose acetate butyrate.

There are several machines that appear to do a satisfactory job. So far as we have been able to ascertain, there are no manufacturers of any type of fully automatic equipment. However, several manufacturers offer equipment that could be considered semi-automatic.

In general, it would appear that items which are to be skin packaged probably would be packaged by the manufacturer rather than in an intermediate packaging operation. However, imported or semi-manufactured items could well be packaged in some intermediate type operation.

There is growing stimulus on the matter and manner of packaging not only in our own country, but also in other countries throughout the world. It has been stated that 75% of the sales in the large self-service type stores are impulse-type sales. With the growing costs of steel, glass, and even paper in the packaging field, many people are looking to plastics for the answers. In many types of packaging, a thin film of plastic will adequately display, protect, and sell the merchandise.

It is possible that the skin packaging and vacuum-forming equipment of today will require certain advances for the packages of the future. Since our country is geared to mass production and "bigness" in many ways, these requirements unquestionably will be passed on in the case of equipment for skin and blister packaging. This will mean higher speed operations with greater automation. Some of the present equipment available operates semi-automatically and uses continuous rolls of plastic film fed to the vacuum-packaging unit. As pointed out earlier, there is some limitation as to the height or depth of draw.

The automotive and appliance industries have spare parts that offer excellent potentials for skin and blister packaging. It would appear that these types of application rely largely on laminated films which will mean a minimum of M.V.T. as well as excellent shelf life or storage stability. This phase of the packaging industry is in its infancy, but its growth potential and the sales impact that can result from further improvements in films and equipment could well enable it to become the Goliath of tomorrow's packaging industry. —THE END

Universal Moulded Products' 35-foot reinforced plastics boat withstands the highly corrosive off-shore oil field waters.

Dorsett Golden El Rey features a hull and deck of Iso-Glas, an Isophthalic polyester resin reinforced with glass cloth.

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New Techniques for Molding Linear Polyethylene

Recommendations are given on material type, molding equipment, and design of parts and molds for high-density polyethylene

THE need for more free-flowing resins was established early in the field trials of high-density polyethylene. Limitations in the part's "developed area" that could be molded economically with an 0.7 melt-index resin was one determining factor. Considerations such as nominal thickness, number of gates, size of gates, and size of shot versus machine size all exert control, but this moldable area for 0.7 material usually was considered to be about 300 square inches. The difficulty encountered in filling out thin-wall items (0.015-0.030 inches) and the excessive temperatures required in the use of pin-point gates were other concerns in using 0.7 melt-index resin.

The production and use of higher melt-index resins represents a major step forward in new techniques for molding linear polyethylene. Materials now are available in both Ziegler and Phillips types in more than 15 varieties of high-density resin alone.

Material

Melt index is a measure of the flowability of high-density polyethylene, and depends primarily on molecular weight or chain length. It is determined by a standard ASTM test, and refers to the gram-weight of material that will flow through a standard orifice under fixed conditions of time, temperature, and pressure.

In low-density polyethylene, several factors affect melt index. For example, it is possible to maintain a constant molecular weight and vary the type of side-chain branching, thereby varying the melt index. The 0.96-density resin, however, has insufficient side-chain branching to affect flow appreciably. Changes in melt index are effected primarily by increasing or decreasing the molecular weight and, consequently, the main chain length. An increase in melt index represents a decrease in molecular weight and gives a more free-flowing resin.

Simultaneous with the development of high melt-index resins for ease of molding was the investigation of external lubricants as flow promotors in low melt-index resins. Various levels of zinc stearate were incorporated by dry mixing, and their effects on material flow and physical properties were determined.

Based on a paper presented at the National Technical Conference, Society of Plastics Engineers, Inc., Detroit, Mich., Jan. 29, 1958.

Table 1. Effect of External Lubricant on High-Density Polyethylene.

Amount of Zinc Stearate Lubricant, Parts	Min. Molding Temperature, °F.	Izod Impact Strength, Ft.-lbs./in. Notch*
None	340	16.7
0.02	320	16.5
0.05	320	17.9
0.5	300	17.9

*Impact strength depends on specimen dimensions and molding conditions. Values shown were obtained on ⅛ x ½-inch injection molded specimen bars.

Table 2. Typical Physical Properties of High-Density Polyethylene.

	ASTM Test Method	Polyethylene of 5.0 Melt Index	Polyethylene of 0.7 Melt Index
Density, gm./cc.	D238-52T	0.96	0.96
Heat distortion temp. at 66 psi. load, °F.	D648-45T	180	185
Impact strength, Izod, ft.-lbs./in. notch	D256-54T	3*	18*
Max. flexural strength, psi.	D790-49T	5,500	5,500
Tensile stress at yield point, 0.2-in./., psi.	D638-52T	3,300	3,600
Tensile elongation, %	D638-52T	1,000	1,000
Hardness, Shore "D"	D676-49T	65	65

*Impact strength depends on specimen dimensions and molding conditions. Values shown were obtained on ⅛ x ½-inch injection molded specimen bars.

Table 3. Spiral Flow of 0.96-Density Polyethylene.

Material Melt Index	Material Temperature, °F.	Molded Spiral Length, In.
0.7	580	9.9
5.0	580	15.5

Machine Conditions: Injection pressure, 1,000 lbs. gage
Cycle time, 45 seconds
Die temperature, 150° F.

Table 4. Molding Study* of 0.96-Density Polyethylene.

Material Melt Index	Material Temp., °F.	Die Temp., °F.	Inj. Pressure, Gage-Lbs.	Cycle Time, Sec.
0.7	620**	130	1,000	135
2.0	480	120	1,000	135
5.0	420	120	1,000	135

*Machine, 100-ounce preplasticizing unit injection; single-cavity center-sprue mold; 10-gallon pail molding weighing 57 ounces and having a wall thickness of 0.120-inch.
**It is recognized that this temperature is excessive and above the maximum value recommended for high-density polyethylene.

Table 5. Further Molding Study* of 0.96-Density Polyethylene.

Material Melt Index	Temperature, °F. Cylinder	Temperature, °F. Die	Inj. Pressure, Gage-Lbs.	Cycle Time, Sec.
0.7	420	160	800	70
2.0	390	140	600	65
5.0	380	140	600	60

*Machine, eight-ounce; mold, single-cavity, center sprue, chrome plated; and part, salad bowl with wall thickness of 0.073-inch.

Table 1 shows that a level of 0.05, by weight, of zinc stearate gives only a 7% decrease in minimum molding temperature. Levels of 0.5% and above caused surface irregularities. This study showed the minor effects of zinc stearate as an external lubricant, and ruled out further work along this line. The benefits of such a material admittedly is more pronounced on resins with higher coefficients of friction, such as the cellulosics and polystyrene, than on high-density polyethylene.

The materials supplier constantly endeavors to establish realistic laboratory test programs that will correlate with field behaviors. Such techniques are essential in predicting the behaviors of new resins prior to their use in production machines. However, the pressures and temperatures used in the melt-index test are considerably below conditions used in actual field applications, so an additional test method was selected.

The spiral flow mold currently is being employed as a laboratory tool to study and compare flows of various materials. This tool also is useful in studying the various types of polyethylenes, since melt index alone does not correlate between them. Studies are conducted by employing constant machine conditions of time, temperature, and pressure, and varying the material or the melt index of the material used. Spiral length is a measure of processability. Figure 1 shows a lay-out of a spiral flow mold. The spiral flow length can be calibrated, based on a typical dimensional lay-out, as shown. Reproducibility of test results is good, and is about $\pm 2\%$ when taking the average of 10 shots at a given condition.

Table 2 gives a comparison of typical physical properties of two resins of 0.7 and 5.0 melt index. There is little or no change in the properties of rigidity, hardness, tensile strength, and heat distortion temperature. Since these primarily are functions of polymer density, Izod impact strength values show what might appear to be a significant difference. In practical impact tests, however, the three foot-pound level of a 5.0 melt index resin provides good toughness in recommended parts designed specifically for linear polyethylene.

Practical drop-impact tests have been performed on 5.0 melt index moldings, and they have been found to withstand at least 50% of the practical impact level of the 0.7 melt index resin. In addition, the high melt index resin gives an excellent molded part finish.

Table 3 gives a spiral flow comparison of two polyethylenes, and it can be shown that the high 5.0 melt index resin gives 57% more flow under fixed injection machine conditions of time, temperature, and pressure than the 0.7 melt index resin. The characteristic high mold shrinkage of linear polyethylene also has been of slight concern in both molding and part tolerances. Recent articles have established that excessive shrinkage values are related to the use of excessive temperatures. The ability to mold large areas or thin walls with a high melt index resin at temperatures below 500° F. is advantageous in shrinkage control.

Table 4 gives a further study of actual field molding of these materials, illustrating the temperature differences on equal cycles to produce acceptable moldings. The data shows a temperature reduction of 80-200° F. in favor of the high melt index resin. Table 5 establishes the faster cycling usually possible through the use of lower temperatures with a 5.0 melt index resin.

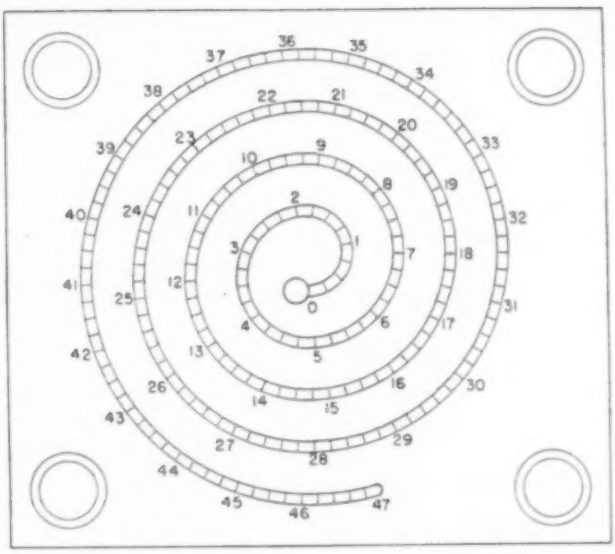

Fig. 1. Lay-out of a spiral flow test mold.

Figure 2 is a graphic illustration of the combined influences of material temperature, mold temperature, and cycle time on mold shrinkage. Actual material temperatures are listed, as opposed to injection cylinder instrument temperatures. Mold temperatures were determined by surface pyrometers. Shrinkage values refer to shrinkage parallel to flow, and were determined on 0.125-inch thick, end-gated tensile specimens. The increased shrinkage with shorter cycles is caused by the fact that the parts can undergo uncontrolled shrinkage when they are removed hot. High shrinkage values also are associated with high temperatures.

Figure 3 gives a considerably broader look at spiral flow data versus melt index for 0.96-density polyethylene. It was found that the spiral flow increased with increasing melt index. The major effect on flow occurs between 0.2-5.0 melt index, and only a slight increase in flow is noted above this value.

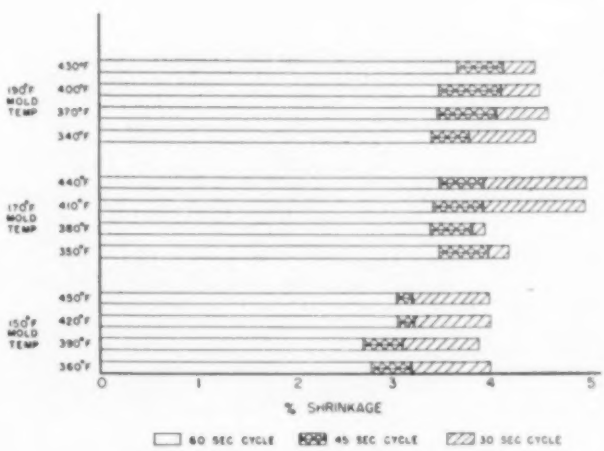

Fig. 2. Mold shrinkage of 0.96-density polyethylene.

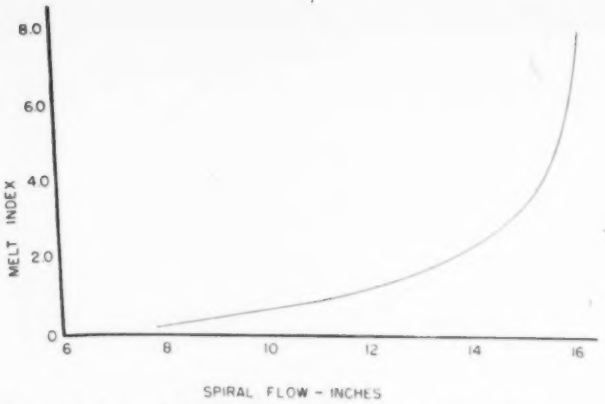

Fig. 3. Spiral molding curve for 0.96-density polyethylene.

Injection Machine

Only through the use of preplasticizing-type injection molding machines has it been possible to consistently produce large pieces with the lower melt index resin without degrading the material. Trials in 120- and 150-ounce equipment have shown that the resultant more uniform melt temperature obtained with these preplasticizers is advantageous. Even at the 60-ounce level, the preplasticizing unit is preferred over the single-cylinder machine.

The combination of high melt-index resins and preplasticizers has made it possible to successfully mold pieces weighing 70 ounces in cycle time of 115 seconds. Equipment with high-speed injection is advantageous for moldng 0.96-density polyethylene. However, injection speed is not the only consideration, since heating efficiency is at least of equal importance. High-speed, automatic equipment is used readily with the high melt-index materials, and cycles of six seconds for thin-wall items have been established in production runs. It should be pointed out that careful consideration should be given to injection hold time or ram forward dwell time in conjunction with high-speed injection. Short injection hold time (1-5 seconds) is recommended to minimize packing and resulting locked-in stress and orientation that also can cause distortion and warpage.

Part Design

Several recommendations can be offered to assist in the successful use of high-density polyethylene through proper part design. These involve radii, taper, edge reinforcement, thickness, and ribs.

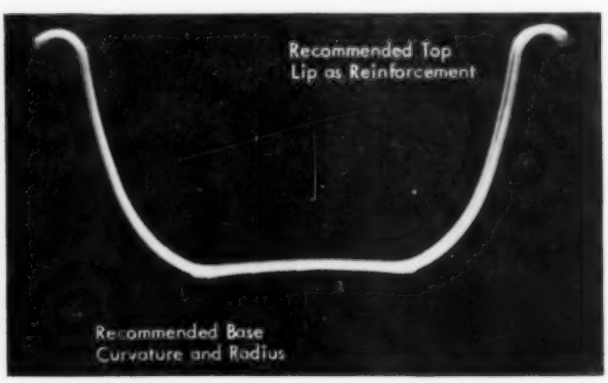

Fig. 4. Cross-section of part incorporating design recommendations on base, curvature, radius, and lip.

RADII. One of the most important rules in part design concerns the use of adequate radii. The maximum permissible radius should be used at the junction of side-walls and the junction of side-walls and base. General radii also should be provided on all rib structures to eliminate points of stress concentration.

PAPER. Shallow draw, non-symmetrical parts should have sufficient wall taper to check distortion. Maximum permissible wall taper for parts less than 4-5 inches high with large projected areas is recommended. Trials with pieces incorporating only 1½-2° taper gave distortions with center sprues. Parts having a draw of three inches, projected area of 36 inches, and a taper of 5°, however, were molded successfully with a single center sprue without warpage and without the benefit of reinforcing ribs.

EDGE REINFORCEMENT. Top edge or rim reinforcement is desirable in part designs for high-density polyethylene. Pieces tested of unsymmetrical shapes having non-reinforced rims showed distortion or bowing in of the sides with single sprues, while similar parts wth top edge support in the form of ribs or contours were satisfactory. This technique of part design is accepted practice with low-density polyethylene, and should be followed also with high-density resin.

THICKNESS. The thickness of the molded part offers additional control in the production of quality pieces. It has been possible to produce center-sprued, flat discs by the use of low material temperature (330° F.) and a part thickness of 0.125 inch. In these cases, there is sufficient physical strength and reduced shrinkage in the molded piece to hold it free of distortion. The same part, however, will take on a saddle warp when molded at high-temperature (550° F.).

RIBS. Successful trials have been carried out in the utilization of ribs as a means of controlling shape in non-symmetrical, center-sprued parts. Rib structures running parallel to the long direction of the piece will serve to promote more linear flow and, consequently, result in truer shapes. The use of a circular rib around the sprue, located approximately ½-inch away, also is recommended for large-area parts where possible. This rib will introduce turbulence and break up jetting or severe orientations.

Concentric rib sections in the base also may be used to good advantage for controlling piece shape. Additional stability may be introduced by joining these ribs with transverse ribs at 90° angles. Figure 4 shows a cross-section of an actual part incorporating design recommendations for linear polyethylene. The following features should be noted in the illustration:

(1). The base incorporates a slight crown for maximum strength.

(2). A generous radius has been provided between side-wall and base.

(3). Side-wall taper exceeds 5°.

(4). The top incorporates a lip reinforcement.

Mold Design

Die construction for high-density polyethylene, in general, should be more rugged than for low-density polyethylene. The temperatures and pressures required for the new materials result in higher material pressures in the cavity. Mold design, in this regard, can be related to features employed for polystyrene and cellulosics with regard to locking cores and providing positive part ejection.

Gate Location

Previous reference has been made to published reports on high-density polyethylene shrinkage. It has been shown that shrinkage parallel to flow is greater than shinkage at right angles to flow. Values have been given as 0.030 inch per inch parallel to orientation, and 0.0335 inch per inch at right angles to orientation. This differential shrinkage continues to be an apparent cause of distortion in polyethylene.

Additional studies have been performed on non-symmetrical moldings to determine the effect of gate location. Figure 5 shows a non-symmetrical, one-compartment box run on a three-plate mold. The original specimen incorporated a single center sprue, and has displayed excessive side-wall distortion. The part then was run with diagonal corner sprues, and radial flow again caused an over-all twist.

Optimum results in this study were obtained from the use of twin sprues at one end of the base to give linear flow, as near as possible. Additional successful trials have been run with several sprues along the center-line of the long dimension on rectangular shapes.

Studies on a similar one-compartment box have been performed to evaluate edge gates as a mold design technique to build-in linear orientation. Optimum results here were obtained by the use of several balanced gates placed along the end of the piece.

In view of differential shrinkage, it is important to establish gate locations prior to building a mold. Changes in gating, primarily edge gates, that change molecular orientation of the material may also affect important part dimensions.

Mold Cooling

Adequate mold cooling is of particular value in dies designed for high-density polyethylene. Separate cooling channels are recommended for the sprue area in both the core and cavity halves of the mold. Without this technique to temperature control, it is difficult to maintain the uniform mold temperatures required to produce good moldings on competitive cycles. Production runs on molds with uncooled cores are difficult because of the rapid temperature build-up in the mold.

Sprue Size & Design

Large-area moldings in high-density material are practical with pin-point sprues only if several sprues are used. Single sprues of $\frac{3}{32}$-inch opening diameter or smaller on large pieces make it necessary to use excessive temperatures, and should be avoided. It appears that single sprues for large-area parts should be approximately ¼-inch or larger in diameter of opening.

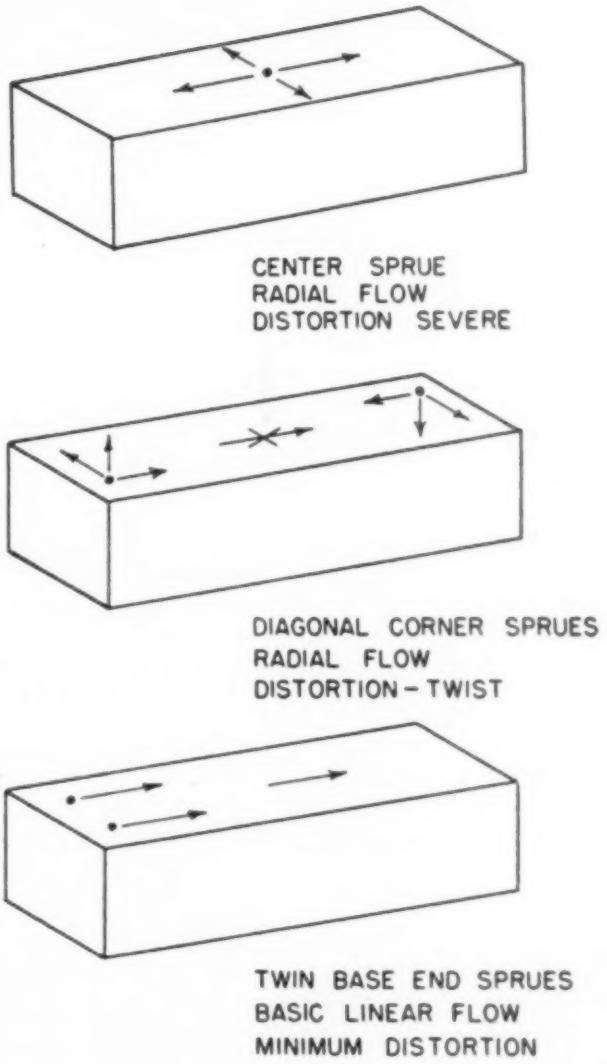

Fig. 5. Non-symmetrical, one-compartment boxes run on a three-plate mold, using three methods of sprue design and location.

Conclusions

Three specific areas should be investigated carefully when considering techniques to be employed in using high-density polyethylene. These involve material type, molding equipment and operation, and part and mold design. Production and application of high-density polyethylene is expanding rapidly. The continued compilation and use of design, application, and molding data is a requirement for continuing this rapid expansion and successful utilization of high-density polyethylene.

Acknowledgment

The author wishes to express his appreciation to the members of the Celanese Sales Development, Technical Service, and Product Application Departments for their contributions to this paper.

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Dry-Coloring Methods for Injection Molding of Polyethylene

Results of an investigation show that rigid polyethylenes can be dry-colored effectively and economically by using conventional equipment supplemented with a simple, inexpensive dispersion plug.

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IN this era of attractive colors for practically every phase of plastics applications, it is essential that new resins which are to attain large-volume usage be subject to coloring by inexpensive methods. This is particularly true in the field of injection molding where housewares, appliances, and related items must not only have appeal, but must also match or blend with color schemes of the intended surroundings. The inherently white, rigid polyethylenes that can obtain a high surface luster, offer a wide range of possible colors for very attractive and serviceable items.

The coloring of polyethylenes for injection molding has been accomplished for some time by blending the natural resin with dry powdered pigment in various types of mills or extruders, or by simply dry-blending the colorant with the natural resin and injection molding. The latter method is desirable from the standpoints of economics and colored-resin inventory, but sometimes results in color dispersions that are unsatisfactory for certain applications. However, in many operations where small gates or small nozzle openings are used, a satisfactory color dispersion can be obtained.

With the rigid polyethylenes, the same general principles apply. Although some other methods produce superior results, "dry coloring" often is the most attractive, economically, and good color dispersions usually are obtainable in items coming from molds with small gates. However, the use of pin-point gates for molding large or thick section items from rigid

Based on a paper presented at the National Technical Conference, Society of Plastics Engineers, Inc., Detroit, Mich., Jan. 30, 1958.

polyethylenes sometimes is impractical.

This paper deals primarily with evaluated results acquired from an investigation of methods for obtaining maximum dispersion of dry colorants in a rigid polyethylene without realizing objectionable effects due to pin-point gates.

Dispersion Plugs

The most logical approach to coloring the rigid polyethylenes appeared to be with the use of dispersion plugs in the nozzle of the injection molding machine. Some of the commercially-available plugs and other types used in the plastics industry were evaluated for their efficiency in coloring a 0.9 melt-index, rigid polyethylene. Extra-large pellets were used for this work, and the pigment was of an inorganic, hard particle, red type that was known to be difficult to disperse. The dispersion was rated against numbered standards by visual inspection of a 0.035-inch thick injection molded disc, sprue-gated at the center. A nozzle with a 0.125-inch opening was employed in these tests.

Although some improvement in appearance was obtained, these particular plugs did not produce the desired results with this resin. The most promising plug consisted of two ¼-inch perforated plates held in position by a connecting threaded rod. Examples of the types of plugs investigated are shown in Figure 1.

A close examination of the molded specimens from several tests indicated that two basic problems existed: (1) The pigment agglomerates which necessitate the breaking up of the large particles; and (2) The small amount of pigment covering the surfaces of the comparatively large pellets requires a uniform mixture with the entire volume of the pellet.

With this information and the knowledge that pin-point gates improve color dispersion, it was reasonable to assume that plate plugs containing small appertures would give an improvement in color uniformity of molded items. By using plates containing a small number of very small holes, the pigment agglomerates were disintegrated, but the resulting specimens were quite streaked. A plate plug with larger holes having greater land length produced a specimen with relatively uniform appearance, except for visible specks of pigment agglomerate.

A plug combining these two types of plates, and having small holes in the back plate, gave considerable improvement. The investigation revealed, however, that the size, shape, and number of the small holes were critical variables. Holes larger than 0.025-inch did not effectively break up the pigment particles and, because of these small holes, considerable pressure-drop was experienced unless the land length of the holes was kept to a minimum. The magnitude of this problem was greatly reduced by employing a conical approach to the small holes, thereby reducing the length: diameter ratio to approximately 1:1. (See Figure 2).

The number of these small holes also was found to be important because too few caused excessive pressure drop, while too many resulted in inferior dispersion. This information indicated a relationship between dispersion and the shear response of the resin going through the apertures.

A summary of the effects of the number of 0.020-inch diameter holes in the plate plug upon the dispersion of color and upon the pressure drop of the polymer passing through the plug can be seen from Figure 3. These data were obtained by determining the pressure required to fill the cavity, both with and without a dispersion plug. A standard 10-D-8 ounce injection molding machine with an injection rating of 10.8 cubic inches per second was used for this study. Figure 4 shows specimens molded without a dispersion plug, with two commercially-available dispersion plugs, and a two-plate plug developed in these studies. This latter plug consisted of a rear plate with 22 holes, each 0.020-inch in diameter, and a front plate with 32 holes, each 0.041-inch in diameter with a land length of 0.25-inch.

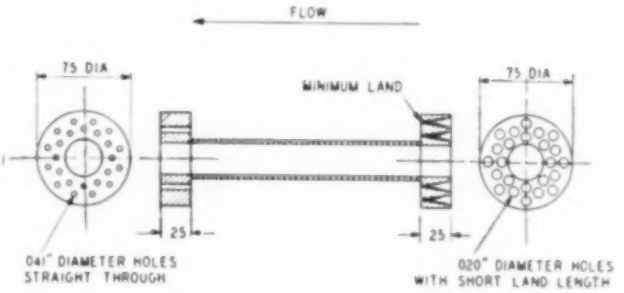


Fig. 2. Cross-sectional drawing of two-plate of dispersion plug with conical approach to small holes.

Fig. 1. Types of dispersion plugs investigated for injection machines; plate, polyliner, pineapple, ball bearing.

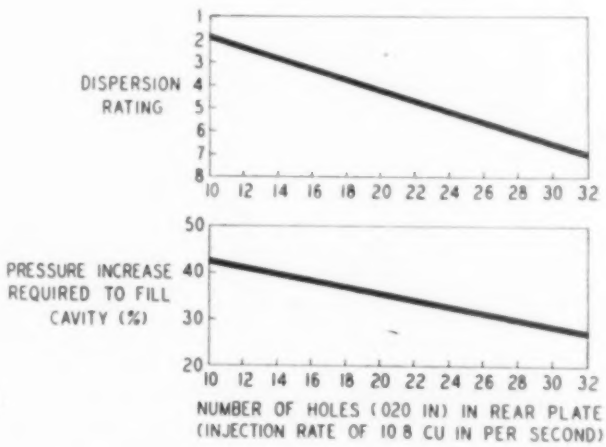


Fig. 3. Effects of number of holes in rear plate of dispersion plug on color dispersion (above) and pressure requirements (below).

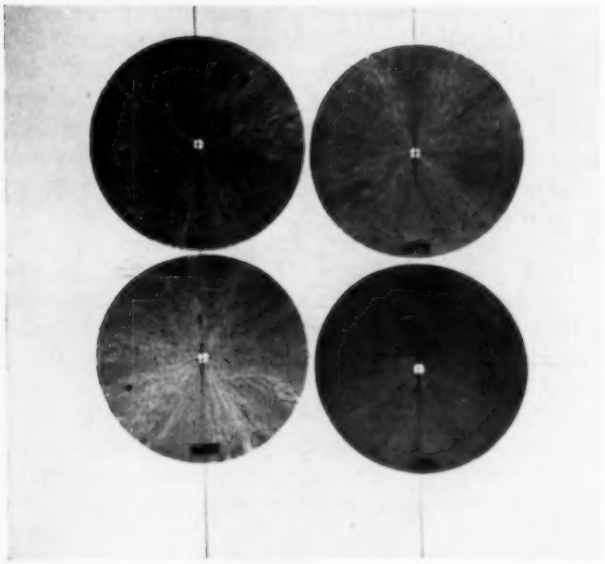


Fig. 4. Three types of dispersion plugs and a control used in the dry-coloring study.

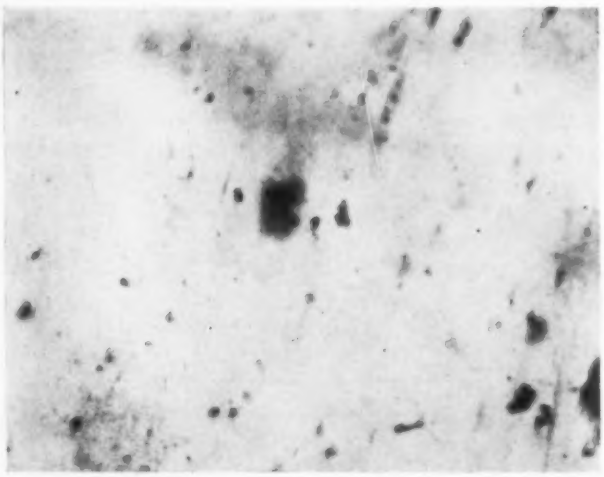


Fig. 5. Photomicrograph of specimen molded without a dispersion plug in the injection machine.

Fig. 6. Photomicrograph of specimen molded from large resin pellets, using a dispersion plug.

Assuming that the optimum number of small holes for this type of dispersion plug is dependent on the injection rate of the machine and the resin velocity per hole, the date in Figure 3 can be used to determine the optimum plug for a given operation. For example, if the color dispersion and pressure requirements obtained with this 22-hole plug are satisfactory, the correct number of holes for the rear plate can be calculated by dividing the injection rate of the machine to be used by the velocity per hole for this particular plug (0.49 cubic inches per second).

The larger holes in the front plate do not appear to be as critical. A ¼-inch thick front plate containing 32 holes, each 0.041-inch in diameter, was used as a companion for the investigation of variations in the other plate. To translate this information for design purposes, the correct number of these large holes for the front plate can be determined by dividing the injection rate of the machine to be used, in cubic inches per second, by 0.34, the velocity per hole for this particular plate.

Resin Pellet Size

As was mentioned earlier, extra-large pellets approximately 0.19 x 0.19-inch in size were used for this coloring study. As would be expected, it is easier to disperse pigment in smaller pellets.

The volume of 0.12 x 0.12-inch pellets, a size marketed currently, is less than half that of the large pellets used for this study, and is considerably easier to color. There does not appear to be much gained by using pellets smaller than 0.12 x 0.12-inch in size, since other problems are encountered. A dispersion plug is necessary regardless of the pellet size. Figures 5, 6, and 7, respectively, are photomicrographs of specimens molded without a dispersion plug, with large pellets and a dispersion plug, and small pellets with a dispersion plug.

Melt Index

The melt index or melt viscosity of the resin determines the shear stresses that are encountered as the resin is forced through the holes in the disper-

Fig. 7. Photomicrograph of specimen molded from small resin pellets, using a dispersion plug.

sion plug. The rigid polyethylenes with melt indices higher than the 0.9 melt-index material used for this work also can be colored readily with the type of dispersion plug developed in these studies, but appear to require a smaller number of holes in the rear plate to obtain equal color dispersion.

Wetting Agent

The amount of wetting agent used to coat the pellets before the powdered pigment is added appears to be an important variable in the coloring of polyethylene. With twin-shell blending equipment, as used for these tests, the wetting agents appear to be unnecessary for the usual small amounts of pigment used. With some of the other types of blending equipment or when large amounts of pigment are to be used, however, it is necessary sometimes to use a small amount of a low-viscosity mineral oil-type wetting agent to coat the pellets prior to pigment addition.

Care should be exercised in the addition of this wetting agent, since an excess will cause pigment agglomeration, resulting in a non-uniform deposit on the pellets. As much as 0.05% wetting agent has been known to cause wavy lines of pigment transverse to the direction of flow in the injection-molded item. The exact amount of wetting agent will vary depending on the amount and type of pigment to be used and the type of blender employed, but usually will be less than 0.02% and, when possible, should be eliminated altogether.

Other Variables

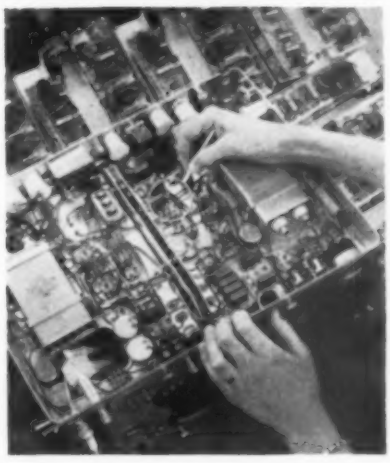
It is impossible to list all the variables that may be encountered in dry-coloring rigid polyethylenes or any other material. In addition to those already discussed, however, the design of the heating chamber of the injection molding machine and the stock temperature appear to have minor effects. Machines with heating cylinders having high internal surface areas appear to give the best color dispersion. In addition, there are indications that the high stock temperatures appear to give a slight improvement in color dispersion.

Conclusions

Undoubtedly, there are other methods for coloring that may be equally satisfactory, but these have not been investigated as thoroughly by our laboratories. This investigation shows that it is possibe to dry-color rigid polyethylenes effectively and economically. This can be accomplished by use of conventional equipment supplemented with a simple, inexpensive dispersion plug of the recommended design.

—The End

Printed Circuitry in Aircraft



Plastic laminate terminal board for ARC's aircraft direction finder being wired and installed in the chassis.

Advanced engineering design has made exacting demands on the manufacturers of navigation and communication equipment for aircraft. One such firm, Aircraft Radio Corp., has come up with a 19.6-pound automatic radio compass system employing printed circuitry. Called the Type 21 Subminiature Automatic Direction Finder, it uses as its terminal supports, a laminate made up of continuous-filament woven-glass bonded with a melamine resin. Synthane Corp. supplies the material under the trademark NEMA Grade G-5.

The new direction finder weighs less than a third of what earlier ADF systems weighed. Most of them are still in use on airline and military aircraft. Weight, however, is not the only reason for adopting printed circuitry. These laminates, which provide the terminal supports for resistors and capacitors in the complex wiring of electronic navigation systems, maintain carefully calculated dimensions under all operating conditions. Their high strength is coupled with temperature resistance from far below zero to flame heat.

With the addition of two Dow Corning 1107 silicone fluid coatings, followed by baking, the boards meet ARC and U. S. Government requirements for humidity absorption and leakage resistance. Inorganic, they do not support fungus growths. Actual performance properties are reported as follows: tensile strength, 30,000-37,000 psi.; flexural strength, 38,000-44,000 psi.; modulus of elasticity in flexure, 1,500,000-1,700,000 psi.; Shea strength, 20,000 psi.; Rockwell M hardness, 120; arc resistance, 180 seconds; maximum constant operating temperature, 300° F.; dielectric strength of a 1/16-inch specimen, short time test, 350 volts per mil; and water absorption of a 1/16-inch specimen in 24 hours, 2.7%.

—The End

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Injection Molding and Extrusion of "Moplen"*

A discussion of possible processing difficulties and probable causes, together with suggested remedies.

WHEN a new thermoplastic makes its appearance on the market, two basic general questions are asked concerning the material. First, what are the properties of the end products formed from the new resin? Secondly, how does the material handle on existing commmercial processing equipment?

The properties of Montecatini's "Moplen" polypropylene have been described and illustrated extensively in the literature since its introduction during the latter part of last year. This article deals with injection molding and extrusion of "Moplen" polypropylene, and presents technical information obtained by experimenting with this new isotactic polymer.

The following discussion will serve as both a guide and starting point in handling a material that shows considerable potential, and promises to play a leading role among thermoplastic materials. Since polypropylene is such a new thermoplastic, however, experience should be acquired by each individual processor on his own machines to obtain precise and accurate working conditions for each specific press or extruder.

"Moplen" polypropylene can be injection molded and extruded utilizing the same methods and equipment generally used for other thermoplastics with only minor adjustments. Like all thermoplastics, "Moplen" has its own processing characteristics. Figure 1 compares the area of moldability of "Moplen" polypropylene with those of high-impact polystyrene and low-density polyethylene.

Injection Molding

Because of the different hot processing characteristics of "Moplen," the suggestions given below should be noted to obtain best results.

CAPACITY OF THE MOLDING PRESS. The weight of the molded object must never exceed the capacity of the press.

INJECTION PRESSURE. Injection pressure may vary over a very wide range, depending on the shape, surface, thickness, and weight of the molded piece. In general, the pressure should not be lower than 1,200 kg./sq. cm. (about 17,000 psi.). Higher pressures (e.g., from 1,500-2,000 kg./sq. cm. (21,000-28,000 psi.), such as are used for nylon, are preferred. In certain molding jobs, however, pressures of 800-1,200 kg./sq. cm. (about 11,000-17,000 psi.), such as those used for polyethylene, can be used, but this is not adviseable for every mold. At any rate, low pressures require slower cycle times.

Molds

SPRUES, RUNNERS GATES. All known conventional injection molding systems can be used with "Moplen," but large sprues, runners and gates are preferred. Ob-

*Montecatini trademark for polypropylene.

viously, the exact diameter depends on the piece being molded.

Small passageways, though possible to use, require high pressures and temperatures that may cause yellow stains in the final molded piece. Small passageways especially should be avoided for large-surface pieces because, in addition to presenting processing difficulties, they also may cause excessive internal stresses and consequent deformation after removal of the piece from the mold. Furthermore, they may cause surface undulations.

SURFACE. Polypropylene faithfully reproduces the surface of the mold. Therefore, it is necessary to chromium-plate the mold to obtain glossy surfaces.

With certain molds, some difficulty may arise in opening the molds due to sticking of the polymer to the highly polished, chromium-plated mold surfaces. In such cases, one surface of the mold can be chromium plated, but not polished, to facilitate removal of the piece from the mold. This can be the surface of the mold corresponding to the surface of the piece that is less interesting esthetically.

MOLD TEMPERATURE. The mold should be kept hot, not below 50° C. (122° F.). The most suitable temperature will be determined by the individual mold, the dimensions of the piece, and the molding cycle.

Injection Temperature

Many factors influence selection of the injection temperature. These include particular type of "Moplen" polypropylene used; the weight of the piece in comparison with the capacity of the injection machine; the shape and dimensions of the sprue, runners, and gates leading to the mold cavity; pressure; cycle time; the shape of the torpedo; and the dimensions of the cylinder.

Temperature-recording devices do not always present the true temperature of the material in the cylinder. It is necessary to distinguish the actual temperature of the polymer from that of the recorded reading. The actual molding temperature of polypropylene should be between 200 and 250° C. (392 and 482° F.), and should never exceed 270° C. (518°F.).

Long stops in the cylinder at temperatures near 300° C. (572° F.) will cause severe polymer degradation. The polymer will be very fluid, may form gas, and will be emitted in the form of jets when the cylinder is cleaned out with the mold opened or detached.

As a general rule, the polymer temperature should increase progressively as it approaches the nozzle.

CYCLE. "Moplen" polypropylenes permit rather fast cycles, even with hot molds. It is adviseable to maintain the pressure for 10-20 seconds following injection. Specific time depends on the dimensions of the piece.

SHRINKAGE. The average shrinkage varies from 1-2%. Low injection temperatures and too-rapid cycles will cause greater shrinkage.

PRE-DRYING. Polypropylene does not absorb water and, therefore, does not require pre-drying. If the material gets wet during transit or in storage, however, the product can be dried out by heating at about 50-60°C.

LUBRICATION OF THE MOLD. Under conventional molding conditions, polypropylene does not require lubrication of the mold. In fact, it is adviseable not to use lubricants because they spoil the high gloss of the molded piece.

Possible difficulties or faults encountered in molding, together with their probable causes and suggested remedies, are shown in Table 1.

Extrusion

"Moplen" polypropylene can be processed by both single- or double-screw extruders. The types of screws used for polyethylene also are excellent for polypropylenes, but a compression ratio of 1:4 is preferred. For accurate results, the screws should be run at slow speeds.

The temperature of the extruder barrel should increase progressively from the hopper to the head. At the head, the temperature should be slightly reduced. In some cases, such as with large straight-head extruders for film, it may be necessary to increase the temperature of the head somewhat.

Suggested extrusion temperatures are as follows:

For film, 190-220° C. (374-428° F.)
For wire, 200-220° C. (392-428° F.)
For pipe, 190-210° C. (374-410° F.)

Cooling methods for extruded products are as follows:

Flat film—Transparent film can be obtained by quick cooling in water.

Blown film—Rather slow cooling should be used for blown film. Blow air gently on the outside of the film.

Wire—Cool rather slowly in blown air, or cool for some distance in room-temperature air and finally in water.

Pipe—Cool quickly with water as the pipe emerges from the sizing die.

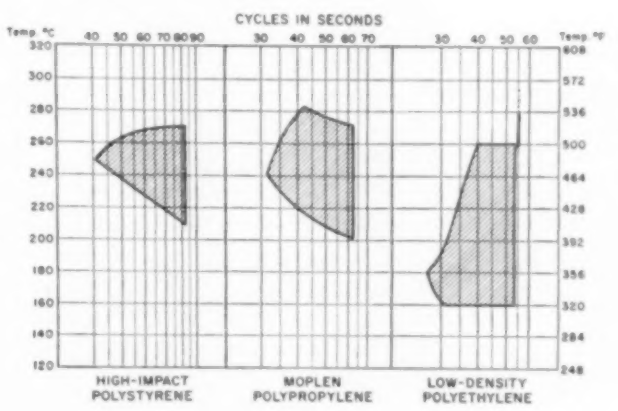

Fig. 1. Areas of moldability determined with the same mold and the same injection molding press. Areas of moldability are indicated by the shaded sections. The upper line in each case is made up of maximum molding temperature points above which overheating and burning occur. The lower line consists of minimum molding temperature points below which incomplete filling of the mold takes place. Minimum molding time (shortest cycle) is shown by the left limit of the area. The right side is limited by a line representing twice the shortest cycle time.

Table 1. Difficulties, Probable Causes, and Suggested Remedies for Molding "Moplen."

Difficulties or Faults	Probable Cause	Remedy
Incomplete filling of mold.	Insufficient pressure.	Increase pressure.
	Insufficient heating.	Lengthen cycle time or increase temperature gradually.
	Nozzle cold when starting up. Cold mold.	Heat nozzle with gas flame. Reduce or remove flow of cooling water in mold.
	Sprue, runner, or gate too small. Back pressure of entrapped air in molds.	Increase cross-sectional area. Create or increase venting.
Removal of molded piece from mold is difficult.	Insufficient cooling; piece sticks to mold.	Delay opening of mold and, if necessary cool mold.
	Adherence to highly polished, chrome-plated mold.	Polish chromed male mold, do not polish chromed female mold (or vice-versa).
	Mold taper insufficient.	Increase taper.
	Piece shrinks on and adheres to male part of mold.	Decrease cooling time in mold; keep male part and female part at different temperatures.
	Insufficient knock-out pins; pins not located properly or not operating simultaneously; rough mold surface.	Mechanical modifications and repairs (adjustments, polishing).
Part deformation after removal from cavity.	Insufficient cooling in mold.	Increase cooling in mold. Dimensional stability is obtained by using long cycle times and high injection temperatures in hot molds. Dip pieces in water as soon as removed from mold, or cool in a form.
	Stress caused by uneven cooling due to strong variations of thickness.	Modify design of piece.
	Defective performance of knock-out pins.	Modify or repair pins.
Interior delamination around gate; stratification (onion skin).	Cold mold—the material in the core flows through material that already has solidified by being in contact with the wall of the mold.	Increase pressure and injection speed or temperature of mold.
	Hot mold—overheating.	Cool mold near gate.
Flash formation.	Excessive injection pressure.	Reduce pressure of injection machine piston or the diameters of sprue, runners, and gates.
	Material too hot. Defective clamping of mold due to:	Reduce temperature.
	(1). Insufficient pressure.	(1). Increase clamping pressure.
	(2). Foreign material or roughness between contacting surfaces.	(2). Clean or grind contact planes.
Surface undulations.	Shrinkage caused by:	
	(1). Insufficient feed. (2). Thick sections.	(1). Adjust feed. (2). Lengthen pressure time following injection, and enlarge section of sprue and gates; increase injection temperatures.
	(3). Pressure and injection speed insufficient.	(3). Increase pressure.
	(4). Time of pressure insufficient.	(4). Lengthen time of pressure.

(Continued on next page)

Bubbles.	Gas developed by too-hot material.	Reduce temperature of cylinder.
	Shrinkage due to delayed solidification of the core with respect to outside surface in sections of great thickness.	Increase injection pressure, always using hot molds.
	Condensation of moisture on granules.	Pre-dry.
Poor welding.	Mold incompletely filled.	See "Incomplete filling of mold."
Silver radial splay lines.	Material cold.	Increase temperature of injection.
	Molds cold.	Increase temperature of mold.
	Condensation of moisture on mold.	Dry and heat mold.
	Entrapped vapor.	Pre-dry granules.
Dull radial splay lines.	Material too hot.	Reduce temperature of injection.
Yellow specks.	Beginning degradation of polymer due to overheating.	Reduce temperature of cylinder and accelerate cycle time.
Burns (black lines or points at edge of piece).	Improper venting.	Create or increase venting.
Materials dropping from nozzle when molds are open.	Degradation due to overheating; polymer becomes too fluid and develops gas.	Reduce temperature and discharge cylinder cautiously with opened molds.

—THE END

Introducing Our New Engineering Editor

Lee J. Zukor joined our editorial staff this month as Engineering Editor. Born in 1914, he received his college education at Columbia University, Brooklyn Polytechnic Institute (where he obtained a B.S. in Mechanical Engineering), and New York University (where he took post-graduate courses).

From 1934-42, he was employed by Edward G. Budd Co. as group leader in the design of the RBI cargo airplane; Brewster Aeronautical Corp., as project designer in charge of hydraulic design of aircraft; and Schirgun Corp., as hydraulic engineer on automatic hydraulic mechanisms for gun design. From 1942-45, he was project engineer for Machine & Tool Designing Co. and did design and supervision of engineering of automatic machinery and plant lay-out. During this period, he also acted as Consultant Mechanical Engineer for Westinghouse Laboratories and Bell Telephone Laboratories where he was in charge of design work on electronic equipment. From 1945-49, he was a Mechanical Engineer for H. K. Ferguson Co. and was involved with supervision and checking of chemical process equipment designs. From 1949-51, he was Project Engineer for Eastern Engineering Co. and supervised the design of a servo-controlled hydraulic press for the production of television and related tubes, as well as other duties directly related to plastics. He was Engineering Supervisor for Kaufeld Associates from 1951-53, and supervised plant lay-out and laison between Newport Chemical Works and DuPont on a titanium metals producing plant. From 1953-55, he was Chief Engineer for Allied Ordinance Co., and from 1955 until the present was Assistant Chief Mechanical Engineer for Singmaster & Breyer.

In the plastics field, his experience has been quite broad. He was responsible for the operations conducted by General Electric Co. in moving its plastics work to Taunton, Mass., from previously existing plants in Pittsfield and other locations. Mr. Zukor worked with National Metalizing Co. in an advanced program for the continuous metallizing of plastics webs in widths up to 54 inches; with Cello-Masters in making polyethylene act more suitable in household products; and with another firm in setting up procedures for the automatic dipping and drying of cellulosic plastics items.

In his work for PLASTICS TECHNOLOGY, Lee Zukor will visit plastics processing plants to write stories and articles on techniques being used there; write a monthly engineering column; and attend society meetings to make editorial contacts and present technical papers to the industry.

—THE END

Mold Design for High-Density Polyethylene
(Cont'd. from page 541)

In general, the physical properties of finished molded parts, such as impact strength are better if the piece is valve gated. The reasons for this are that the parts can be molded under lower pressure, less heat on the materials, and less heat on the mold, resulting in parts that are free from stresses, poor welds, and warpage. Scrap losses definitely are decreased, because there are fewer short shots, no cracks around the sprue, no bubbles causing holes where the sprue attaches to the piece, and no side gates to tear into the piece upon ejection. Finishing costs are reduced, since there are no gates or sprues to be trimmed. Flush cut-off is even better from the finishing viewpoint than that achieved with hot runner or pin point gates. The weight of the finished molded item also usually is less by multiple valve gate molding.

Valve gating makes automatic molding possible on many parts, since there are none of the many problems connected with sprue or pin point gates. When comparing this method with the present methods of mold design, we have found that production can increase from 15% to 30% using this method and, in some cases, up to 100%.

We believe that success in designing a mold hot-runner construction and valve-type gating depends largely on design ability. All designing techniques used in heating cylinder construction must be employed when designing this type of mold construction. Sharp corners and places where the material can lodge must be avoided. There must be adequate temperature control of the plastic material in the hot runner system, and all the latest techniques of proper nozzle design must be incorporated. The fits of all moving parts are very important; parts should be hardened and ground, and fitted very well. Seats and joints should be well fitted. The hot runner mechanism must be made extremely accurate and timed in sequence with the mechanism of the injection molding machine.

Conclusions

In conclusion, we feel that the hot runner and valve-type gating could be used to great advantage when molding high-density type polyethylene. This principle lends itself very readily to the production of large, thin sections in high-density polyethylene items at good, economical, profitable cycle rates. This type of design can be applied to existing molds at a moderate cost.

This new design is a challenge to the mold-making industry, and will transform some molds from dormant pieces of steel to precision mechanisms.

Acknowledgements

Acknowledgements are due the following for the assistance of their unpublished data: Columbus Plastic Products Corp., Columbus, O.; Mario Maccaferri, Mastro Plastics Corp., New York, N. Y.; DeMattia Machine & Tool Co., Clifton, N. J.; West Instrument Co., Chicago, Ill.; Eagle Tool & Mold Co., Hillside, N. J.; and Plastic Mold Co., Inc., Rutherford, N. J.

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—THE END

Dielectric Heat-Sealability of Films
(Cont'd. from page 544)

added. Material "F" was the same as "B" with 1% of lubricant added. For each material, five samples were tested and the typical data spread was about ±10%. The powers at points "A and "B were measured, and are presented as arbitrary units in the Table.

It appears that the presence of TiO^2 results in increased power requirements for the seal. The blue pigment and lubricant caused deformation at a lower power level, but the actual sealing was impeded. These are typical data and, before any conclusions can be drawn, many samples would have to be evaluated.

Using the "B" material, the effect of film speed was investigated. The results of these tests are given in Table 2. These data indicate that more than sufficient power is put into the seal at the slower speeds. As the speed increases, a point is reached where the power input must be increased also to keep the seal conditions in equilibrium.

As another test, "B" material film was folded over. The results given in Table 3 were observed: Except for six thicknessses, it appears that the power required for the seal, P_B, is independent of the thickness for the films tested. The data presented are sketchy, but nevertheless are indicative of the measurement that can be made. The values for absorbed power, P_A and P_B, would have to be corrected (lowered) to account for losses in the tank circuit. By calibration, the arbitrary units P_A and P_B could be converted to power readings, in watts. The order of power required was about 7.5 watts for the three-mil films used.

Conclusions

The apparatus described is promising in terms of the sample test data presented. Work will continue on a systematic study of heat-sealing parameters. These parameters have been difficult to define and, of course, to measure, but this equipment will provide a basis for future investigation. Applications are foreseen in both product control and development, and in aiding the technician in his production problems. —THE END

Heating Element for Missile Dome

Wire-mesh heating tape is affixed so as to provide even heating.

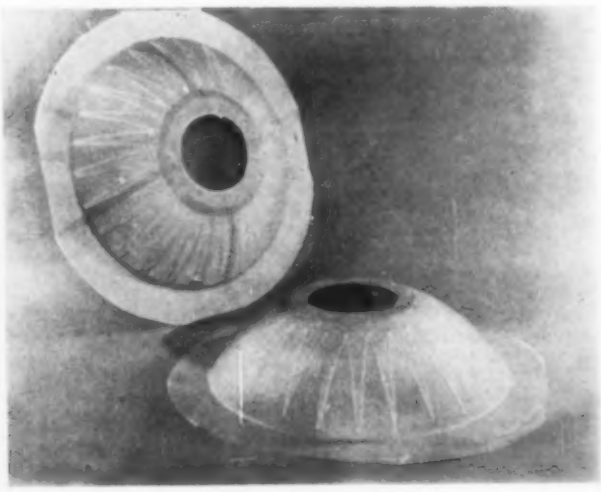
GIVEN—the problem of designing and building a heating element which would fit snugly against the dome of a missile, provide high watt density, and withstand temperatures up to 300° F. In addition, the heating element would have to be extremely light, and occupy as little space as possible.

This problem was presented to Electrofilm, Inc., North Hollywood, Calif., manufacturer of solid film lubricants and temperature control equipment for aircraft and missiles. The firm's engineers designed a wire mesh heater consisting of resistance wire woven in glass cloth, laminated between two layers of resin-impregnated glass cloth.

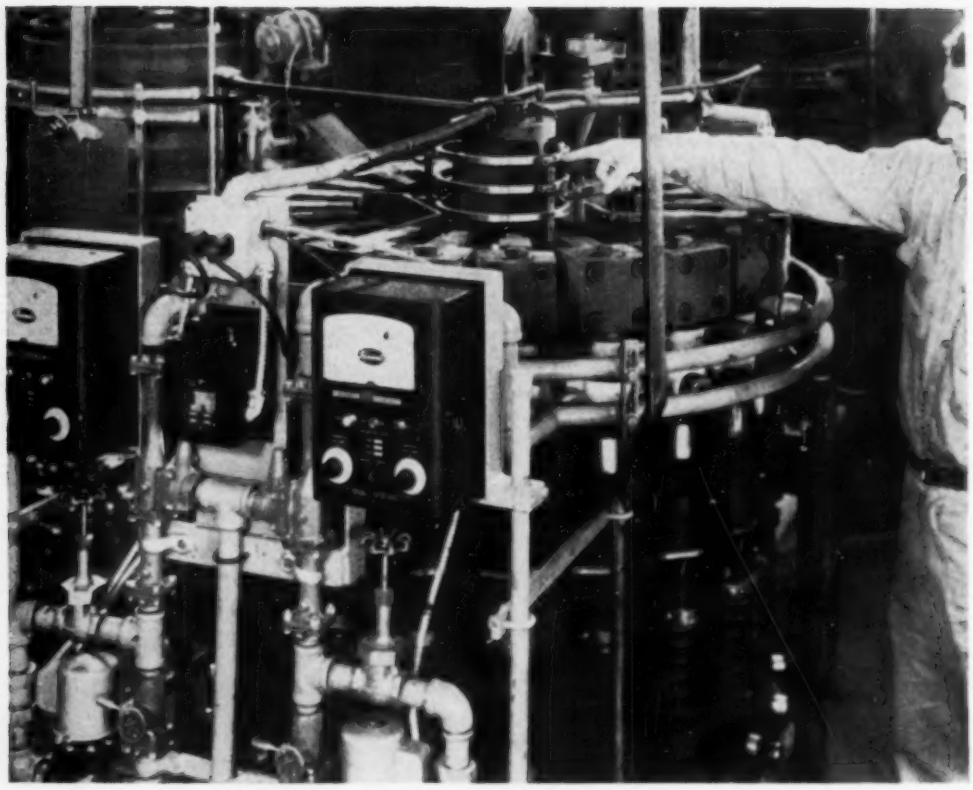
Conolon 506, a resin-impregnated glass cloth produced by Narmco Resins & Coatings Co., Costa Mesa, Calif., was found to meet all requirements. Cut to pattern, the Conolon was positioned over a metal mold and "heat-tacked" to form the first layer. The wire and glass mesh, in tape form, then was affixed over the Conolon layer. Following the laying-down of another layer of Conolon, a silicone rubber bag was placed over the lay-up and evacuated. Cure was completed in an oven, set at 300° F., for one hour. The trimmed heater weighs approximately 13 ounces. —THE END

After laying-up a second layer of Conolon, a silicone rubber bag is superimposed and evacuated.

Resin-impregnated cloth is cut and positioned over metal mold.



One-hour cure at 300° F. gives the heating unit which, when trimmed, weighs but 13 ounces.



Bush-and-ring connection is the key to temperature control on this Cropp rotary press. Note Fenwal controllers mounted on the side of the press, away from heat and vibration.

Boosts Production, Lowers Reject Rate

SYLVANIA Electric Products reports a 25-40% increased production rate and a reduced reject rate from 2% to ½% through the installation of thermistor-type temperature controllers on its rotary compression presses. The control set-up was devised by Cropp Engineering division, El-Tronics, Inc., manufacturer of the presses, and is based on the Series 560 Indicating Thermistor Controller produced by Fenwal, Inc., of Ashland, Mass. Both Cropp and Sylvania's molding plant are located in Warren, Pa.

The older method of temperature control employed a mercury bulb with capillary connections between sensing bulb and controller. With a rotary press, it was necessary to mount the controller on brackets which rotated with the press. Being in the center of the press, the controller was subjected to high heat which attacked the wiring, and to continuous jarring which affected the mechanical linkages and switch mechanism. This caused temperature drift from the control point, frequent breakage of the capillary tubing, and required the operator to walk around the press for readings.

The new controls were installed on nine of the 16 Cropp presses at the Sylvania plant. These presses develop up to three tons pressure per head, operate automatically, and contain 20 molding stations arranged on a circular frame work. Each station consists of a pair of cast iron platens; the upper supplying the force, and the lower containing the mold cavity. Temperature of the upper and lower platens is controlled independently to compensate for differential heat losses and part configurations. Heat is applied to the platens as they rotate past two groups of 2-inch radiant-heat gas burners arranged on two, fixed, circular manifolds surrounding the press.

Each of the two groups of burners is controlled by the aforementioned Fenwal thermistor controller. The sensing probes are inserted in two specially-cored platens; one upper and one lower. Leads from the thermistor probes are wired to a pair of spring-loaded, ⅜- by ¾-inch serrated copper brushes which are mounted on insulated supports fastened to the rotating part of the press. The temperature-sensing signal is

picked off each set of brushes as they wipe against ½- by ½-inch bronze collector rings fixed on the stationary center post. These probe signals are brought out through conduits to the two Fenwal controllers. Since the controller is mounted away from the press, it is not subjected to the ambient heats mentioned previously, nor is it jarred or difficult to read.

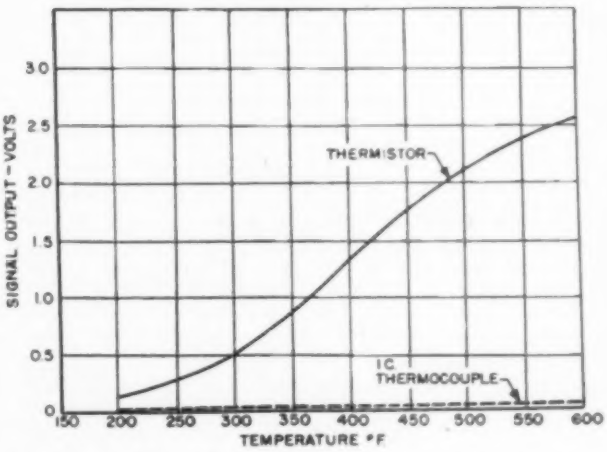
Mold temperature is controlled by regulating the flow of air-gas combustion mixture to each burner manifold. This mixture is produced in a low-pressure air inspirator which draws gas under negative pressure in proportion to the flow of air. The air supply is split, with about 40% of the flow reaching the inspirator through a by-pass line. A solenoid valve in this line is cycled by the Fenwal controller in response to the probe temperature in the platen. Full fuel flow is supplied to the manifold when the mold is below temperature, and the by-pass is shunted off by the solenoid to permit cooling when the platen is at or above the control setting. This method of splitting the fuel supply is analogous to using separate groups of heaters; one to provide maintenance heat, and the second to cycle additional heat as needed.

The 110-volt source for the controllers is supplied through the magnetic motor starter of the press. This prevents the controller from switching to high heat if the press is stopped for adjustment or minor repairs. The starter deenergizes the relay in each controller to close the by-pass solenoids when the machine power is off. Temperature control, therefore, is within narrow limits—a useful factor in reducing over-shoot.

With over half of the presses converted, direct comparisons could be made between the bulb-and-capillary controllers, which were original equipment, and the new transistor controllers in actual commercial production of phenolic sockets and closures. According to plant foreman, G. E. Miner, the converted presses could be controlled within five degrees of setting temperature. The non-converted presses were controllable only within 15-20 degrees.

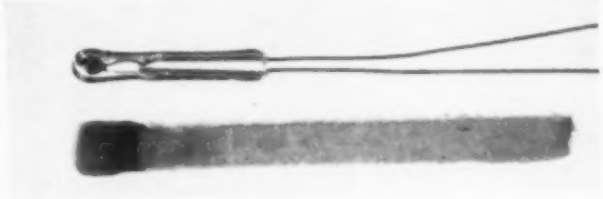
Closer temperature control permits stepping-up the platen temperature by 30 degrees to 360-400° F., depending upon the part, without danger of blistering. Higher operating temperatures shorten molding cycles, thus resulting in a higher press output. The converted presses are producing 25-40% more parts per day than the non-converted presses molding identical parts. Improved temperature control also cut the reject rate from 2-½%, it was reported.

According to David Cropp, vice president and general manager of Cropp Engineering, "the technique to transmitting a temperature-sensing signal through collector rings is practical only with thermistors." "Their extraordinarily high output," he added, "is due to the low resistance loss between collector rings and brushes." Standard iron-constantan thermocouples generate less than 0.005 volt per 100° F. temperature change, whereas the output of a thermistor in its balanced-bridge circuit is 0.5 volts for the same temperature change. This is 100 times as great; therefore, the resistance loss at the collector ring interface has a negligible effect on the output of the thermistor probe. High inaccuracies would result, however, in transmitting signals from even the most precise thermocouple. —THE END



Thermistor immediately picks up temperature changes, transmitting them to controller.

Cropp presses, with Fenwal controllers, shown in actual operation at Sylvania. Fourth and fifth units are not yet converted, thus enabling side-by-side comparison.



Actual "working unit" of thermistor probe is about the size of a paper match head.

Nylon Parts for Timing Motors

NYLON and nylon combinations are playing ever increasing roles in the manufacture of quiet, long-running timer motors. Low surface friction has eliminated both noise and the need for lubrication. Other advantages offered by nylon include low thermal expansion, high modulus of elasticity, and moldability to close tolerances.

Molybdenum disulphide-filled nylon (Polymer's Corp.'s Nylatron GS) was selected by Bristol Motor division, Vocaline Co. of America, for use as washers in its standard four-watt Circle B timing motor. Stamped from strip by Polymer Corp., the washers are used on the high-speed rotor shaft between the rotor pinion and its frame. Weighing but a few grams, they support the pinion as it rotates at speeds of 1,800 rpm.

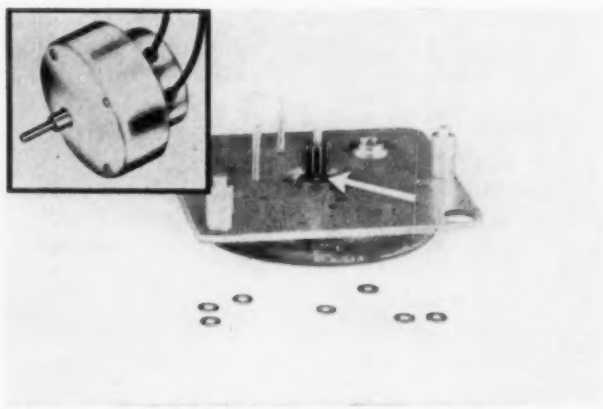
In addition to eliminating chatter, the filled-nylon washers met all requirements of chemical resistance, operating at temperatures to 100° C. The part is expected to have a service life of several years, and has been shown to outlast general-purpose phenolic, fibre, and the various metals tested.

Lux Clock Co., Waterbury, Conn., chose nylon bearings molded by Gries Reproducer Co., to replace sintered bronze in its synchronous motor for stove timers. Many of the dimensions on this part must be held within two mils; angular relationships are established within ½ degree, and concentricity is set within four mils. Further, the bearing surface of the cone must be perfectly smooth.

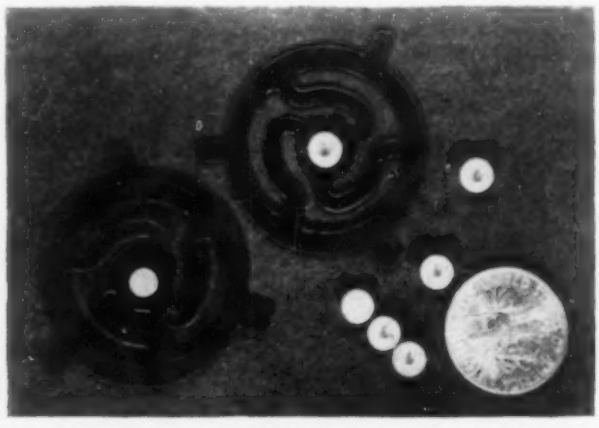
Conventional ring-and-cap bearings seemed to offer little advantage over the sleeve type; and graphite bearings, though better than sintered bronze, could not be held to close tolerances. Prime advantage of the nylon bearings was the "no-lubrication" feature. The sintered bronze bearings formerly used required an oil reservoir for lubricating the shaft. Most lubricants are adversely affected by the heat of the stove, and either dried or formed gummy residues.

Four-year tests at rotor speeds of 600 rpm. have shown no measurable wear on the GRC nylon bearings. Viewed under a high-power microscope, they show only a highly polished bottom radius. Sintering was a troublesome operation also, requiring elaborate jigs and fixtures to assure alignment. Reject rates were still high.

Front and rear bearings on the motor are very much alike in design, varying only slightly in length and cone angle. Since nylon will take color, it was very easy to eliminate confusion by using a natural color for the spring-loaded bearing and black for the stationary bearing. The latter is staked cold into the outside plate of the gear reduction unit, and the former is hot-staked into a flat steel spring which keeps the rotor shaft under just the right amount of compression for noiseless operation. —THE END



Arrow indicates filled-nylon thrust washer.



Tiny nylon bearing is hot-staked into flat steel spring. Note size comparison with the dime at lower right.

News of the Societies

SPE New York Section

Members and guests attending the April 16 meeting of New York's SPE section were treated to a departure from the usual program of highly specialized subjects in the plastics field. Guest speaker on this occasion, which took place at the Governor Clinton Hotel, was Hugh Odishaw, executive director, United States National Committee for the International Geophysical Year. His topic was, "Scientific Implications of the I.G.Y."

A scientific inquiry, commanding worldwide cooperation, I.G.Y.'s primary objective is to gather synoptic data in the fields of meteorology, geomagnetism, gravity measurement, ionospheric physics, cosmic radiation, glaciology, oceanography, and seismology. Data gathered at outposts set up by 66 participating, and 70 cooperating nations are teletyped to a central information agency operated by the National Bureau of Standards at Fort Belvoir, Va. Here the information is coordinated and evaluated in terms of a complete global picture of geophysical conditions throughout the world.

I.G.Y. had two major antecedents, both of which were dubbed "International Polar Year." The first, which took place during 1882-1883, comprised arctic expeditions from 12 nations. During this investigation, surface meteorology, geomagnetism, and the aurora borealis were studied. The second I.P.Y. was arranged in 1932-33. It drew the combined efforts of 40 nations and, while explorations were still confined to the arctic regions, the scope of interest had broadened to include ionospheric physics.

Seedling discussions in 1950 led to plans for a third "polar year" whose name was modified to "International Geophysical Year" in order to embrace the multiple fields of interest that had since grown up. Each country executes its own program under a general plan developed by the cooperating countries, and coordinated by an international committee. At present, more than 10,000 scientists and technicians, in addition to several thousand volunteer observers are working to gather data in support of the program.

Of what value is I.G.Y.? While some information is of immediate interest, the major portion of the data will serve as a repository of information for future research work. New developments, in the shape of rockets and satellites, serve as tools for the geophysicist in sounding the upper atmosphere. The rockets measure atmospheric pressure, temperature, and density; the earth's magnetic field, especially during auroral displays; night and day air glow; solar radiation; auroral particles; ionospheric charge densities; and ozone distribution. Observations over a longer period of time are made possible by satellites which move about the earth in elliptical orbits at distances ranging from 350-1,500 miles. Information thus obtained is telemetered back to earth where it is received and transmitted through the network of observation stations.

In the Antarctic, seismic soundings are used to map the buried rock surfaces and to measure the amount of snow and ice covering the continent. This information is important in studying ocean currents and their relation to marine food stocks, and also in determining the earth's heat and water budget.

The full implications of this mass scientific endeavor can only be determined through the perspective of history. I.G.Y. investigations will terminate at the end of 1958, but certain phases of the program will require an extension. The problems involved are planetary in nature and require international cooperation in order to by-pass the restrictions imposed by political and geographic boundaries.

SAACI Appoints Chairmen

Confirmation of the appointment of committee chairmen for 1958, and a schedule of dates and locations of five golf outings to be held this year, have been announced by the Salesmen's Association of the American Chemical Industry, Inc., New York, N. Y. Included in the group of chairmen approved by the Association's board of directors are: admissions, John M. Glaze, Hooker Electrochemical Co.; auditing, Walter Farley, Charles Huisking & Co.; education, Leroy London, E. I. du Pont de Nemours & Co.; employment, Clifford Heathcote, Monsanto Chemical Co.; entertainment, Paul E. McCoy, American Potash & Chemical Corp.; golf, Frank R. Reynolds, Publicker Industries, Inc.; publicity, Dwight Moody, The Journal of Commerce; sales clinic, Raymond Tower, Westvaco Div., Food Machinery & Chemical Corp.; welfare, George F. Smith, Millmaster Chemical Co.; and committee of tomorrow, Vincent L. Rebak, Grace Chemical Co.

The golf outings are scheduled as follows: May 20, Spring Brook Country Club, Morristown, N. J.; June 26, Dellwood Country Club, New City, N. Y.; July 22, Bonnie Briar Country Club, Larchmont, N. Y.; August 19, Tamarack Country Club, Greenwich, Conn.; and September 16, Hackensack Country Club, Oradell, N. J.

SPE Upper Midwest Section

Members of the upper Midwest section, Society of Plastics Engineers, Inc., met Monday, March 17, at Napoleon's Cafe, St. Paul, Minn. The group was addressed by Dr. H. Arnold and Richard B. Kron, both of General Mills, Inc., who discussed the several aspects of Versamid polyamide resins.

The introductory remarks included an outline of the chemistry of polymers as related to Versamids, and a tabulation of types, properties, and physical forms of these materials. Thermoplastic Versamids have been compounded to produce hot-melt adhesives, and solvent-based adhesives and coatings. Thermosetting types include Versamid epoxy combinations used for paints, adhesives, plastic tooling, potting, and encapsulating.

Honors Founding Chairman

The Western Section of the Society of the Plastics Industry, Inc.'s Tooling Division presented an honor scroll to its 1957 founding chairman, Tony Guerreiro, Short-Run Plastics, at its recent meeting in Los Angeles, Calif. The award was based on his tireless efforts in the creation and leadership of the group.

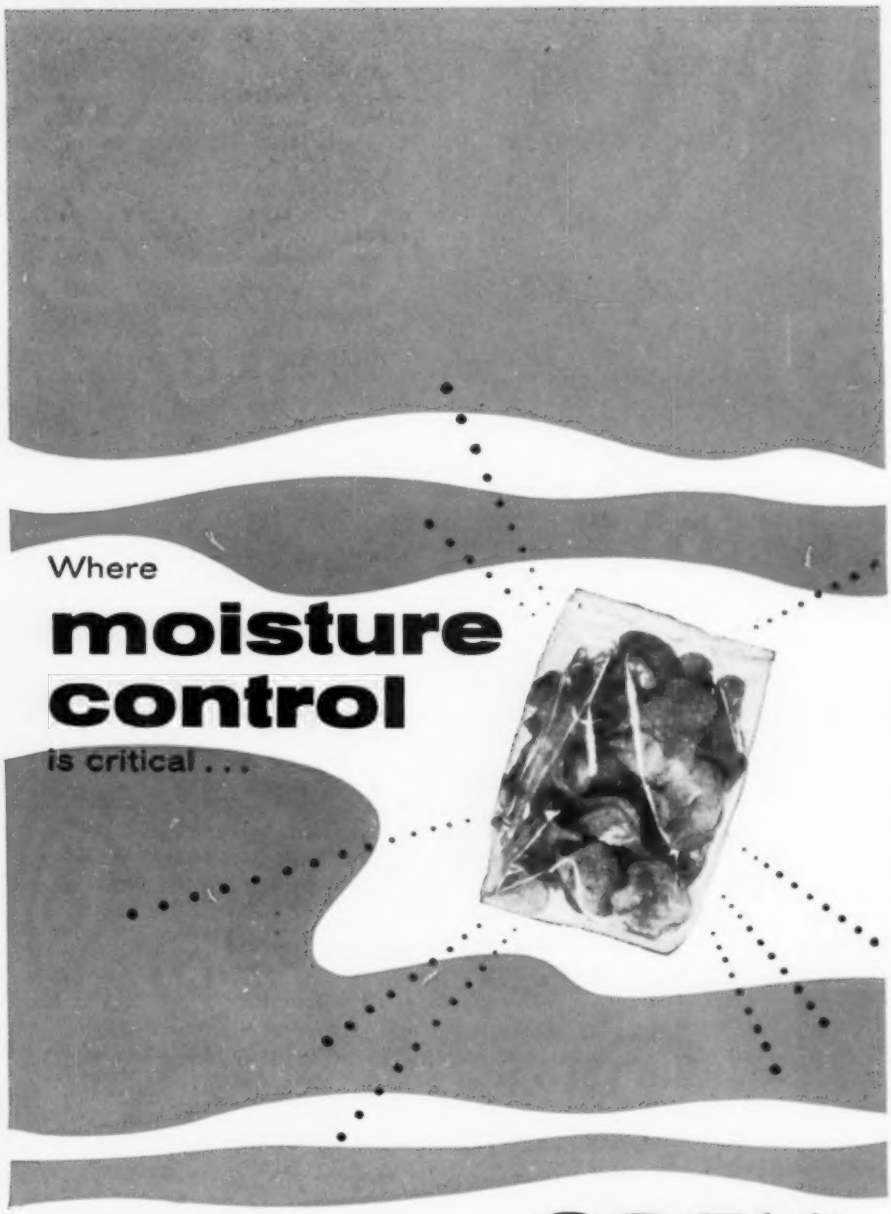
Also named at this time were the officers for 1958: Alan M. Fullarton, Convair Astronautics, chairman; Hal Rumenapp, Douglas Aircraft, recording secretary; Leo Costanza, Douglas Aircraft, vice chairman; and Ray Best, North American, treasurer. Lew Winters of Furane Plastics will serve as corresponding secretary.

Presents Paper on PVA Paint

New developments permitting the use of water-thinned emulsion paints for general exterior use were described in a paper presented by John C. Becker, Celanese Corp. of America, at the Fourth Biennial Symposium of the Pacific Paint and Varnish Production Clubs, held February 28, in San Francisco, Calif.

Mr. Becker, who heads up Celanese's vinyl resins applications laboratory, claimed that PVA paints based on newly-developed formulations, have overcome the problems of peeling, blistering, and scaling that heretofore prevented their use with previously-painted and weathered exterior surfaces. By adding small percentages of toluene or xylene, the paints can be made to penetrate existing coatings, even though they are chalky, dirty, and/or adhere to the surface underneath.

As soon as paint manufacturers adopt the new formulations, homeowners will be able to exploit their ease of application and clean-up in exterior work as well as interior. Other consumer benefits will include absence of yellowing in white paints; superior brightness in tints; and a high rate of vapor transmission.



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Where moisture must be sealed *out*—sealed away from crisp, flavorful potato chips—or sealed *in*—as with moist, succulent foods that can be boiled in the package if you wish—film made of GREX brings a totally new standard of performance to the job.

The secret is its great resistance to moisture transmission. GREX provides a tight, tough barrier . . . keeps moisture from seeping in *or* out.

In thin gauges, film made of GREX is an economical, highly effective food package. Heat-sealed as an "envelope" it has excellent moisture and gas barrier properties . . . clear, attractive and rip-resistant.

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For packaging . . . in construction and agriculture . . . for industrial coatings . . . *this versatile plastic means better products for you.*

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GREX* in action

Unlimited Applications

To preserve perishables, control moisture, and retain *all* the flavor in frozen food packages, GREX shows the greatest promise in protective packaging today.

In sheet form for rigid vacuum formed containers, or in thin films for packaging . . . overwraps, paper coatings, heat-sealed bags, and drum liners are a few possibilities that instantly spring to mind . . . you can expect exceptional quality when you make it with GREX. Its glossy rich finish gives your package additional sales appeal.

Tough, Adaptable

Clear or *frosted*, GREX film is *easily imprinted*. Above all, GREX is *tough* . . . its high density molecular structure forms an almost *impenetrable* moisture barrier even when the *gauge of the film is thin* or in containers with *eggshell thin* side-walls.

Moreover, this superior moisture barrier retains its effectiveness over an extremely wide range of temperatures. This immediately forecasts a brilliant future for transparent packaging of foods stored in the deep freeze until ready to be cooked . . . *in the bag* . . . in boiling water. The packager concerned with *containing the flavor* is going to be looking to GREX.

In brief, if moisture barriers are important in your packaging, we'd suggest that you investigate the use of GREX. You may find that it is *more economical* than your present packaging material.

Other Fields

The fields of agriculture and construction look to GREX for a better future, too. On the farm, silage, mulching, and pond liners are ideal GREX applications. In construction, GREX will provide more effective moisture control under slab foundations and roads.

For More Information . . .

We have the facilities, the people, the production capacity, *and the interest* to help you investigate the potentials offered by GREX high density polyethylene in *any* of these applications. For further information, write to W. R. Grace & Company, Polymer Chemicals Division, 225 Allwood Road, Clifton, New Jersey; or 3555 West Peterson Avenue, Chicago, Ill.

News of the Industry

Sees No Plastics Recession

Two key segments of the plastics industry—mold manufacturers and molders—report orders up to 10-40%, according to a recent report issued by the Society of the Plastics Industry, Inc. Increased activity in these basic plastics operations would certainly imply comparable gains for such key products as radio and television sets, as well as automobiles, the Society pointed out, since such components are usually ordered several months ahead.

Major manufacturing industries caught in a cost-price squeeze are finding plastics a practical means for making their products more attractive and saleable, and at the same time giving them a more favorable price picture. The extensive research and development programs undertaken by the plastics material manufacturers are paying dividends by enabling these materials to enter fields previously thought closed to plastics.

A strong trend toward the use of complex molds for turning out complicated products in a single operation was reported. Here, a single plastics part of involved contour replaces two, three, or more metal parts. Savings in time, labor, and materials are considerable. Metallizing has enabled plastics to overcome certain consumer resistance to the non-metals in such fields as the automotive, business machine, and home appliance.

Housewares Fabricator Expands

An expansion project, valued at more than $1-million, is scheduled for completion this year by Columbus Plastic Products, Inc., Columbus, O. Details of the program include a 110,000 square-foot plant now under construction, and new equipment for fabricating the company's line of Lustro-Ware plastics housewares.

Down To The Sea In Ships

A marine terminal, built on an existing dock-site at Bay City, Mich., was opened this spring by Dow Chemical Co., Midland, Mich. Incorporating a paved working area of 30,000 square feet, the terminal will act as an embarkation point for shipment of Dow's products to its eastern terminals at Port Newark, N. J., and Philadelphia, Pa.; and to its Dutch subsidiary, Nederlandsche Dow Maatschappij, located at Rotterdam, Holland.

The Bay City facility, which can accomodate ocean-going vessels, will handle all of the company's cargo-shipments which previously had been routed through the Port of Detroit. The 1,500-ton Danish ship, M.V. Christel Heering, has been chartered to make several round-trips to Rotterdam this season. Points on the eastern seaboard will be served by a second chartered vessel which travels via Lake Huron, Lake Erie, Welland Canal, Barge Canal, and Hudson River to New York and Philadelphia. Larger vessels will be used with the opening of the St. Lawrence Seaway in 1959.

Makes Resins On West Coast

A Selectron polyester resins plant has been erected and placed in production at Torrance, Calif., by Pittsburgh Plate Glass Co., Pittsburgh, Pa. Located adjacent the company's paint-producing facility, the new unit also provides sales and technical services to west coast customers.

Builds Molding Plant

A newly-erected injection molding plant, enclosing 80,000 square feet of floor space, has been opened by Consolidated Molded Products Corp., Scranton, Pa. The one-story building accomodates sales offices, showrooms, 23 injection presses, and decorating and finishing equipment. Opening of the Scranton plant represents the company's second major expansion during the past year; the first being the establishment of an injection molding facility at Binghamton, N.Y.

Consolidated Products' Scranton plant.

Jay C. Searer

John F. Snyder, Jr.

Decentralizes Durez Division

Hooker Chemical Corp. has decentralized its Durez Plastics division, which will now operate as an autonomous division of the company. Production, sales, and profits now become a divisional responsibility. Facilities involved include the headquarters plant at North Tonawanda, N. Y.; the phenolics molding plant in Kenton, O.; and the wood flour plant in Spokane, Wash.

"Hooker has nearly tripled in size since 1955, making decentralization advisable to achieve maximum efficiency," according to Hooker president Thomas E. Moffitt. He added that ". . . purchasing, advertising, public relations accounting, and legal departments will be handled centrally from Niagara Falls, N. Y. The division's labor relations and plant engineering will, however, be transferred to North Tonawanda."

Jay C. Searer, former division works manager, becomes divisional general manager and reports directly to Mr. Moffitt. Alfred W. Hanmer, Jr., continues as division general sales manager, with responsibilities to Dr. Searer. Other changes within the division are as follows: Charles Y. Cain from administrative general assistant to division assistant general sales manager; John F. Snyder, Jr., from Kenton works manager to production manager for the division; and William J. Parmley, from division supervisor of laboratory production and process development to superintendent at Kenton. Lothar A. Sontag continues as division technical manager.

Licenses Lunn Laminates

Bellingham Shipyards Co., Bellingham, Wash., and Lunn Laminates, Inc., Huntington Station, N. Y., have signed a licensing agreement whereby the latter firm becomes Eastern manufacturer and distributor of the Bell Boy line of reinforced plastic boats. In the marine field, Lunn has produced landing craft for the Navy, lifeboats, one-piece sail-boats, as well as the first submarine fairwaters. For these reasons, Bellingham felt that a working agreement with Lunn offered numerous advantages over erecting and staffing a new facility.

Minimum target for this year is 400 Bell Boy boats, with one-piece Fiberglas-reinforced polyester hulls. Models include the 15-foot Banshee; a 16-foot Express Cruiser; and the Model 404 Express with cockpit, trunk cabin, bunks, sink, head, and water tank. Colors include light green,

yellow, light blue, red, black, white, and two-tone effects. These colors are incorporated into the gel coat.

Drops Price Differential

A geographic price differential fo. laminated plastics, amounting to a premium of 2¢ per pound on West coast deliveries, has been eliminated by Taylor Fibre Co., Norristown, Pa. The price equalization applies to sheets, rods, and to laminated plastics components of other products.

Schedules Midwestern Plant

A phthalic anhydride plant, scheduled for completion in early 1959, is being constructed for Witco Chemical Co., New York, N.Y., by Scientific Design Co., Inc. This plant, designed for an annual capacity of 20-million pounds, will be situated adjacent to one of Witco's existing facilities in Chicago, Ill.

Schedule More Exhibit Space

For the second time since December, the Society of the Plastics Industry has been forced to increase the total number of exhibit booths available at the 1958 National Plastics Exposition. As most of us already know, the event will take place November 17-21, at the International Amphitheatre in Chicago, Ill.

Number of companies exhibiting now totals 187, according to John J. Bachner, president of Chicago Molded Products and Exposition chairman. In response to numerous inquiries, the Society is offering a revised, expanded Exposition floor plan to the nearly 6,500 executives of 4,000 SPI member and non-member companies in the plastics and associated industries.

Auburn Absorbs Norton Labs

Acquisition of Norton Laboratories, Inc., Lockport, N. Y., by Auburn Plastics, Inc., Auburn, N. Y., makes the latter firm one of the largest as well as oldest plastics molding firms in the country. According to Auburn president, John H. Woodruff, the consolidation of compression molding facilities should restore the profit margin by eliminating needless duplications. The Norton plant layout also was felt to be

Auburn's recently-acquired Norton labs.

better suited to efficient compression-molding operations than Auburn's multi-building, multi-floor facilities.

Auburn is a major producer of component parts for automobiles, business machines, and general industry. The firm supplies a large part of the plastic requirements of central New York manufacturers, and serves more than 500 customers throughout the country. In addition to its thermosetting operations, Auburn injection molds and extrudes parts, and produces vinyl compounds and plastisols.

SPI Team To Visit Russia

A group of American plastics manufacturers will arrive in Moscow on June 2, for a month's comprehensive tour of the Russian plastics industry. Specifically provided for by the U.S.A.—U.S.S.R. educational exchange agreement signed in January of this year, the delegation will be made up of the following men: C. Russell Mahaney, SPI president and vp. of St. Regis Paper Co.; C. W. Blount, Bakelite vp.; R. E. Burk, DuPont associate director of research; W. T. Cruse, executive vp. for the SPI; James E. Fitzgerald, plastics manager for Brunswick-Balke-Collender Co.; T. J. Kinsella, Barrett president; V. V. Lindgren, technical director for American Cyanamid; J. J. O'Connell, Consolidate Molded Products president; and T. Shevzov, Naugatuck Chemical.

So little is known here about activities within the Russian plastics industry. If we were to jump at conclusions based on the available plastics literature in Russian, we might assume that they were far behind us. Considering other Russian scientific developments, we know that this cannot be so; and it should be very interesting to get these men's reactions to work going on in Russia.

Participants on both sides should benefit from this exchange, which will bring the Soviet team here in November for the Eighth National Plastics Exposition. They will remain for a month, visiting various American plastics firms.

Installs Paper Coating Machine

A paper-coating machine which can duplicate almost any paper-coating condition such as transfer roll coating, offset gravure, KCM coating, size press coating, air knife coating, and trailing blade coating has been installed at Koppers Co.'s plastics divisional laboratory, Kotuba, Pa. Designed cooperatively by Koppers technicians and the Dilts division of Black-Clawson Co., the machine can coat 20-inch webs at speeds up to 1,100 feet per minute.

Features of the machine include 14-inch metering rolls and 20-inch applicator rolls. Drying of the paper is effected by conveying same through the machine's hot-air tunnel. The unit should enable Koppers technicians to investigate coatings and coating conditions from all points of view.

Coincident with the machine installation, Koppers has announced the development of a paper latex for use in clay coating formulations. Called Dylex Latex KCD-85, the material shows many characteristics of a cast coating, yet can be run on standard on-machine equipment at normal speeds. Gloss ratings upwards of 90 have been reported.

The new latex has the highest styrene content (80%) which can be obtained while maintaining film-forming characteristics. A formulation comprising 20 parts straight styrene-butadiene latex, unplasticized, to 100 parts of pigment first proved successful as a drawn coating at the Kotuba labs. It has since been run successfully on conventional paper coating machines.

Adopts Polyethylene Container

Banish, a dandruff-remover shampoo produced by John H. Breck, Inc., Springfield, Mass., is now packaged in a 16-ounce, high-density polyethylene container produced by Plax Corp. Resin used in this instance is Hi-Fax, a product of Hercules Powder Co., Wilmington, Del.

Beck had previous experience with Plax polyethylene packaging, but before the introduction of Hi-Fax, had considerable difficulties with color fidelity and crack resistance. The new material offered low initial cost, lightness, unbreakability, ease of handling, printability, and shipping economies.

Marlex Polyethylene Tote Box

A tote box for dishes has been made from Phillips Chemical's Marlex high-density polyethylene by Bloomfield Industries, Inc., Chicago, Ill. The box sells for half the price of similar metal units, weighs only one-third as much, and is quiet. For the latter rtason alone, it should find considerable application in restaurants where the noisy rattling of dishes is a source of considerable annoyance. For hospitals, it is a veritable must.

Slush Molding Polyethylene

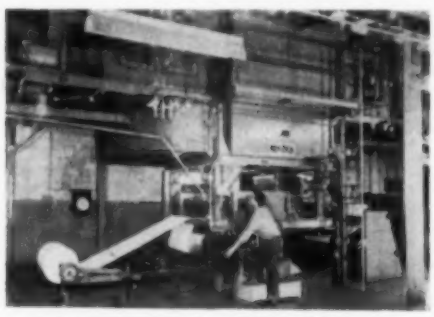
Slush molding—a technique usually associated with vinyl plastisols—has been adapted to the processing of polyethylene by Allied Chemical Corp.'s Semet Solvay division. The new process involves pouring molten polyethylene into a split mold, allowing it to solidify, pouring off the excess, opening the mold, and removing the object.

According to company sources, the process can be used with standard polyethylenes due to their high viscosities. Residual material cannot be poured out of the mold once the walls have been coated. A blend of Allied's A-C Polyethylene 6 (a low molecular weight material) and a high molecular weight polyethylene, which will give an end viscosity of 5,000-10,000 cps. at 300° F., has proven most effective. Test formulations containing 40-60% A-C Polyethylene 6 produced items with the highest tensile strength, best elongation, and least brittleness.

Allied reports that the weight of a molded object is a function of viscosity, setting time, temperature, and molding conditions. As a rule, the use of high temperatures and lower-viscosity formulations give the lowest weights. Polyethylene slush molding is adaptable to small toys, 50-ounce parts, and to individual piece, semi-automatic, or automatic operation. It offers considerable cost advantages in short runs through inexpensive molds and the low pressures required.

Installs Custom Built Oven

A vertical impregnating oven, capable of handling material widths up to 72 inches has been installed at Fabricon Products, Inc., River Rouge, Mich. Designed and built through the joint efforts of John Waldron Corp., and Ross Engineering Corp., the unit is eight feet wide, 20 feet long, 35 feet high, and contains two 28-foot heating zones in its tower. The installation incorporates electronic speed and web-tensioning controls; squeeze rolls which permit precise control of resin content; and temperature control units which maintain oven heat within 1°F., over an operating temperature range up to 400° F.



Fabricon's vertical impregnating oven.

Allied Splits Barrett Division

Allied Chemical Corp. has created two divisions to manufacture and market product lines handled by its Barrett division. Barrett's long-established lines of roofing, building, and paving materials will be separated from the plastics and coal chemicals, and will continue as before under the Barrett divisional name. H. Dorn Stewart will serve as its president.

Plastics, resins, and industrial chemicals will be manufactured and sold by the newly-created Plastics and Coal Chemicals division. T. J. Kinsella, Barrett president since 1952, will be president of that division. The change should permit intensified concentration on research, customer service, and development of specialized markets for each of the product lines involved. Allied's growing stake in the plastics field, as well as its potential in building materials, is expected to be strengthened by this realignment.

Non-Stick Vinyl Conveyor Belt

Another candy firm has switched from canvas to vinyl conveyor belts—Charms Co., Bloomfield, N. J. Manufacturer of Charms lollipops, the firm has experienced considerable difficulty with the candies sticking to the canvas and causing messy jam-ups.

This problem was eliminated in toto by a switch to Koroseal vinyl belting, manufactured by the B. F. Goodrich Industrial Products Co. The smooth, non-porous surface presented by the vinyl not only prevents sticking, but makes cleaning easier and is more sanitary. The tan belts can handle materials at temperatures up to 150° F.

Impact Styrene Cartridge Case

After considerable research and development work, the U. S. Naval Ordnance Laboratory at White Oak, Silver Springs, Md., has come up with a lightweight cartridge case of Cycolac. A product of Marbon Chemical, division of Borg-Warner Corp., the Cycolac case weighs but 2.5 pounds as opposed to the standard 5.9-pound, 105 mm. brass case.

Weight reduction is a very important logistic factor, when one considers that several million rounds of ammunition are required each year by military forces—even in peace time. Of equal or greater importance, Cycolac is a non-strategic material which costs considerably less than the metal presently being used.

Cycolac is characterized by outstanding strength over a wide temperature range. In firing tests, the thermoplastic cases withstood gas pressures of 6,000-35,000 psi.,

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METASAP VINYL STABILIZERS

—designed to give better protection from heat and light. Whether you are producing film, sheeting, floor tile or plastisols, there is a Metasap Stabilizer to do the job.

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—these proven compounds not only improve internal lubrication of molding powders, but act as plasticizers. When dusted on molds, they supply external lubrication and prevent sticking. They also permit molding at lower pressures, help speed the molding cycle, promote longer mold life, improve the finish of the end product.

★ ★ ★

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and momentary flame temperatures exceeding 4,000° F., at the instant of percussion. Not only did the Cycolac cases emerge from the breech unscathed, but some could be reused up to six times. Another advantage, not to be overlooked, is the possibility of adopting identifying color schemes for different types of ammunition.

Use Polyethylene-Lined Pails

Shipment of zirconium sponge, a highly reactive form of the metal used in atomic reactors, posed certain problems until it was decided to transport the material in sealed polyethylene liners within a metal pail. Carborundum Metals Co., world's largest producer of zirconium for nuclear reactors, uses Bakelite polyethylene film liners developed by Cello-Pak Corp. Argon gas is blown into the package as an additional barrier against oxidation.

The pails are lined with film prior to filling, and the sponge is fed out of a hopper. Each pail is weighed, and the film top is folded and sealed. After the lid is sealed in place, the pail is placed inside a wooden box for shipment.

Bee Chemical Absorbs Logo

Logo, Inc., a wholly-owned subsidiary of Bee Chemical Co., has been dissolved and merged into the parent firm. The move coincides with increased emphasis on research and development in the fields of specialty coatings for plastics and vacuum metallizing. M. A. Self, former president of both firms, will serve as president and general manager of Bee Chemical. R. E. Dunning has been elected vice president in charge of manufacturing, a position he previously held with Logo.

Packages Steel in Polyethylene

A transparent polyethylene envelope is being used by Crucible Steel Co. of America to package heavy bars of its precision-ground Ketos oil-hardening Ground Flat Stock. From the user's standpoint, the plastics packaging is said to offer three advantages: the customer may peel back just enough to cut off the required length for a job; the container protects the balance during sawing and can be resealed; the transparency permits the user to determine inventory and length without unwrapping.

New Atlas technical center near Wilmington.

Atlas Opens Technical Center

On May 23, Atlas Powder Co. officially opened its $3-million technical center in suburban Wilmington, Del. Located next to the company's general offices, the two-story and partial-basement structure contains 70,000 square feet of floor space. It will accommodate the basic research and chemical product development facilities, and will house about 150 employes.

Primary goal of the chemical research department is to enhance the company's future technical and financial position through basic research and the development of new products and processes. It includes four sections: organic, physical chemistry, administrative and technical service, and toxicology. Walter H. C. Rueggeberg serves as general director.

The product development department, under the direction of F. Faxon Ogden, is responsible for finding new uses for Atlas products and new products for Atlas markets. This department will guide a potential product from the research laboratory stage through to the commercial item.

The center is equipped with the latest instrumentation and facilities, and contains two, separate air-cooling systems. It was designed and built by the H. K. Ferguson Co., Cleveland, O., working in close cooperation with Atlas' chemical engineering department and with the personnel now using the building.

Plans Phthalic Anhydride Unit

Plans are presently underway for the erection of a phthalic anhydride unit by Kolker Chemical Corp., Newark, N. J. The facility, which is scheduled for completion by the end of the year, will be built adjoining the main plant. Designed capacity is 15-million pounds annually.

To Build PVA Emulsion Unit

A unit for the manufacture of two new PVA emulsions is being built at the Toledo, O., plant of Du Pont's Electrochemicals department, and should be completed in December. Water-resistant, the finely-dispersed emulsions are designed for use in water-base paints. They will be sold as Elvacets, the firm's trademark for polyvinyl acetate emulsions.

Elvacet 1423 is a copolymer which can be used without adding a plasticizing agent, and Elvacet 1440 is a homopolymer which requires the addition of plasticizer to achieve flexibility. These low-cost vehicles may be used for interior topcoat paints, primer sealers, and exterior masonry paints. They are expected also to find uses in the adhesive, textile, and paper industries.

Modified Urethane Foams

Modifications of urethane foams, produced by the addition of variously sized and coated glass fibers, have been developed through the joint efforts of Allied Chemical Corp.'s National Aniline division, and Owens Corning Fiberglas Corp., both of New York City. Principal components of the test foams were: an isocyanate, National Aniline's Nacconate 80; a polyester, Plaskon PFR-4; and Fiberglass in several lengths, screen sizes, and binders.

Density of the finished foam is unaffected when up to 5% by weight glass fiber is used. Various combinations can reduce per cent elongation; and increase resilience, compression set, and compressive strength. Tensile strength, in some cases decreases slightly, although not below that of other cellular materials.

Analysis of laboratory tests indicates that when one specific property of a foam is to be improved, a glass fiber of suitable length and a formulation can produce the desired result. Other physical characteristics, however, must be checked to be certain that they have not exceeded useful limits.

For applications in cushioning, hysteresis loss can be reduced by adding 5% by weight of a $\frac{1}{8}$-inch milled fiber. Simultaneously, compressive strength increases from 0.46-0.68 psi. to help alleviate the problem of slow come-back. High hysteresis losses can be achieved by adding 5% by weight of $\frac{1}{32}$-inch milled fibers. The resulting material has high compressive strength, low elongation, and offers sustained resistance with slow rebound.

Completes Processing Plant

A new plant containing the latest machinery for laminating, printing, embossing, slitting, and sheeting of plastics has been opened by Ridge Printing Co., Inc., Ridgefield, N. J. The firm is now able to laminate all gages of plastics from 2-60 mils, widths to 72 inches, and including 5-ply. Other services offered include printing and coating of plastic sheet and films, as well as embossing. All work is done on a custom basis.

Phthalocyanine Green Toner GA-4804*

SUCo's new Phthalocyanine Green Toner GA-4804

A typical Phthalocyanine Green Toner

What makes it* tick?

The unseen attention to detail in SUCo's new Phthalocyanine Green GA-4804, like the inner exactness of a time-piece, constitutes superiority over typical Phthalocyanine green toners. Each pigment shown was added to vinyl sheeting and given equal milling time on a two-roll mill. SUCo's GA-4804 exhibits an exclusively outstanding facility of rapid dispersion and superior cleanliness in many usages, eliminating costly requirements of pre-grinding or dispersing, insuring uniform production from batch to batch, and yielding a maximum tinting strength. This minimum time requirement considerably reduces color processing costs.

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Names in the News

Bertram A. Graham

Bertram A. Graham, former supervisor of quality control and product development for Ren Plastics, Inc., has joined the product planning department of L.O.F. Glass Fibers Co. He had also served as engineer with U. S. Rubber and as project manager for Owens-Corning Fiberglas.

Carl Fahrenkrug has been assigned to the Syracuse district as a field representative for L.O.F. Glass Fibers Co. He previously was associated with Keasbey & Mattison.

A. C. Hamstead and **H. M. Rife** have been appointed staff associates, and **L. S. VanDelinder** becomes group leader at Union Carbide Chemicals Co.'s development department, South Charleston, W. Va. Mr. Hamstead will serve as a consultant and advisor in materials of construction, and Mr. Rife will perform the same function with respect to vinyl polymers.

J. G. Somers, general manager of Sonsoweld Corp., has been elected chairman of the decorative laminate group, Laminated Products Section, of the National Electrical Manufacturers Association.

H. Dorn Stewart has been appointed assistant to the executive vice president of Allied Chemical Corp. He formerly served as marketing manager of Armstrong Cork's floor division.

H. S. Riggs has been elected vice president and district manager of Plastic Material Sales Co., Inc., Fanwood, N. J., producer of colorants for thermoplastics.

Victor Merrill has been appointed district manager for the parent firm, Plastic Molders Supply Co.; **Arthur Keown** becomes Ohio district manager; and **William Belton** directs the Chicago district office. New office manager in Fanwood is **Leslie Stahl.**

John J. Schmitt has been appointed marketing manager for Kemlite Corp., Joliet, Ill., manufacturer of glass-reinforced polyester building panels. He is the former manager of architects' sales for Celotex Corp.

Robert A. Karasek has joined Chris Kaye Plastics Mfg. Co., Madison, Ill., as sales manager. He brings with him over 18 years experience in molding engineering and sales.

Charles H. Stockman

Charles H. Stockman has been named manager, research operations, at the B. F. Goodrich Research Center in Brecksville, O. Dr. Stockman joined the firm in 1950 as a chemical engineer, and has served continuously with the exception of a year's loan to the Atomic Energy Commission, 1953-1954.

Fred J. Holzapfel has been named director of engineering for Monsanto Chemical Co.'s organic chemicals division, St. Louis, Mo. He succeeds **Proctor H. Avon,** who transfers to the plastics division in Springfield to become its director of overseas manufacturing.

Paul J. LaMarche has been appointed director of production for U. S. Industrial Chemicals Co. Prior to joining USI in 1949, he served with Allegheny Ludlum Steel Corp., E. I. du Pont de Nemours, and Lebanon Steel Foundry. Mr. LaMarche has served USI as manager of sodium sales and as manager of the Ashtabula, Ohio plants.

Paul J. LaMarche

J. Kenneth Craver has been appointed manager of organic products development for Monsanto Chemical Co.'s research and engineering division, Dayton, O. He had been in charge of the applied exploratory research group. **Salvadore P. Lio** has become assistant to the general manager of the firm's overseas division. **Lloyd H. Todd** has been named manager, engineering department, for the plastics divisional plant in Texas City, Tex.

Fred Mattfeld has been appointed works manager for the Curon division, Curtiss-Wright Corp., Quehanna, Pa. He was formerly employed as factory manager for the Eclipse Machine division of Bendix Aviation Corp.

George W. Bechberger and **Walter F. Keleher** have joined the management engineering department of Allied Chemical Corp. The former has been superintendent of maintenance and construction at the Solvay plant in Detroit since 1951. Mr. Keleher served as a chief chemist and chief chemical engineer for Du Pont, and as a consulting management engineer with Joseph M. Cook & Staff.

Jack H. Dollinger

Jack H. Dollinger has been elected vice president, general manager, and to the board of directors of Ferro Chemical Corp., Bedford, O. Formerly sales manager, Mr. Dollinger has been acting general manager since last November.

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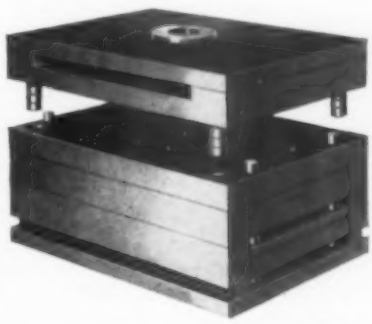

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- D-M-E of CANADA, TORONTO, ONT.: 156 Norseman Ave.

Frank Proctor has been added to the sales staff of Tee-Pak, Inc., Chicago, Ill. He will cover Northern California from headquarters in San Francisco.

A. L. Maiocco has been placed in charge of thermosetting molding equipment for the press division of F. J. Stokes Corp., Philadelphia, Pa. He joined the firm in 1956, after 5½ years in project and sales engineering on presses.

Robert A. Pollock has been elected vice president in charge of production and development for George Degen & Co., Inc., New York City. He previously served as vice president of Brown Allen Chemicals, Inc.

Richard S. Griffith has been appointed to the newly-created position of assistant product manager, industrial containers, for Plax Corp., Hartford, Conn. He formerly served as an engineer with the technical service department.

Nicholas W. Tozza has joined Claremont Pigment Dispersion Corp. as a technical service specialist. He will serve as "troubleshooter" to printers in the New York Metropolitan area.

Richard W. Eddy, former assisant manager of the new chemicals division, Union Carbide Chemicals Co., has been named manager of the department. He joined the firm in 1940 as a chemist.

Thomas E. Powers has been appointed assistant to the sales manager of National Polymer Products, Inc., a subsidiary of Polymer Corp., Reading, Pa. He joined the company approximately a year ago.

Carl E. Holch has been named co-export manager for Globe Slicing Machine Co., Inc., Stamford, Conn., and its wholly-owned subsidiary, Stimpson Computing Scale Co., Louisville, Ky. He formerly served as sales manager of General Tire & Rubber's Bolta division.

Edward A. Taylor has been appointed plant manager of Pennsylvania Industrial Chemical Corp.'s new West Elizabeth plant. A PICCO employe for 12 years, he has been concerned with research, process work, production, and plant operation.

De France Clarke has been appointed manager of Union Carbide Chemicals Co.'s new projects department. He will be responsible for recognition, appraisal, and development of new project ideas.

R. E. Hughes has been named manager of development for Canadian Resins & Chemicals, Ltd. Dr. Hughes is the former director of laboratories for the firm.

Henry Zaccaria has been appointed manager of the purchasing department, International Resistance Co., Philadelphia, Pa. He previously served as tool & equipment buyer, and as assistant purchasing agent. **Edgar M. Corson, Jr.**, has been appointed sales manager of the computer components division. He is the former sales manager of El-Tronics, Inc.

Robert P. Kenney has been appointed director of international activities for B. F. Goodrich Chemical Co., Cleveland, O. He previously served as European director of chemical activities, and as director of product and process licensing.

Charles Lightthipe has been appointed technical director of Nopco Chemical Co.'s industrial laboratories in Harrison, N. J. **Ramsey Christian** has been named director of the industrial development laboratories.

C. Byron Richards has been appointed director of industrial relations for the chemical division of Food Machinery & Chemical Corp. He previously occupied that post at the South Charleston, W. Va., plant of the firm's Westvaco Chlor-Alkali division.

Theodore S. Hodgins, vice president in charge of research of Reichhold Chemicals, Inc., has resigned his post with that company and Reichhold Chemicals, (Can.) Ltd., to open his own office as a chemical research consultant. He will maintain headquarters at 22 Greenley Road, New Canaan, Conn.

Richard S. Ringwalt, former Eastern assistant sales manager for Owens-Corning Fiberglas Corp., has been appointed to the newly-created position of product manager, highway materials.

John A. Battler has been appointed supervisor of the process research group in the research and development department of Acheson Dispersed Pigments Co., Philadelphia, Pa. Before joining Acheson, he was a senior chemical engineer at International Resistance Co.

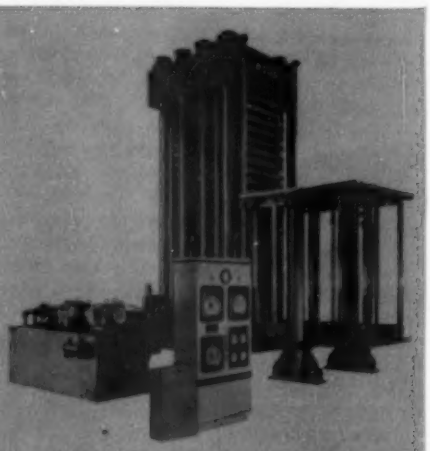
John M. Keenan has been named general factories manager of L.O.F. Glass Fibers Co., Toledo, O. He succeeds **J. H. Plummer,** who has resigned. Mr. Keenan first joined Glass Fibers, Inc., as an industrial engineer.

George L. Fox has transferred to Mobay Chemical Co.'s central offices in Pittsburgh, where he will be responsible for expanding urethane markets in the electrical insulation field. He had been engaged in research and technical service work on urethane wire coatings for the research department.

Lewis A. Curtis has been elected president of Package Machinery Co., East Longmeadow, Mass. He formerly served as vice president in charge of sales. Also elected to office were **Roger L. Putnam, Jr.,** as executive vice president; and **J. Edwin Hanson,** as company treasurer. Mr. Putnam had been the vice president in charge of manufacturing; Mr. Hanson had been and will continue as controller. Election of Mr. Curtis followed the resignation of **Donald H. Dalbeck**, who has been president and treasurer for the past two years. Mr. Dalbeck plans to return to his native Worcester where he has both civic and business interests.

Nicholas H. Alex has been appointed to the market research and development group in the sales department of Acheson Dispersed Pigments Co. He was formerly engaged in polymer research work with Du Pont in the Poly-Chemicals department.

Leonard Elterman has been elected president of Gemloid Corp., Long Island City, N. Y. Mr. Elterman has purchased all the stock and interest of Joseph Frank, founder of the firm in the early 1930's. A veteran of the plastics industry, Mr. Elterman was formerly president of Popular Plastic Products Corp., and several related companies. Carl Haller was elected vice president, secretary, and treasurer of Gemloid.



2,000-ton R. D. Wood Hydraulic Press for laminating and polishing plastics. Press has 10—4" openings, platen size 42"x83", and is of the completely self-contained type, including pumping unit for semi-automatic control of time, pressure and temperature. Press is equipped with hydraulic loading and unloading elevator. Send for complete details of this or other R. D. Wood Presses for the plastics industry, without obligation.

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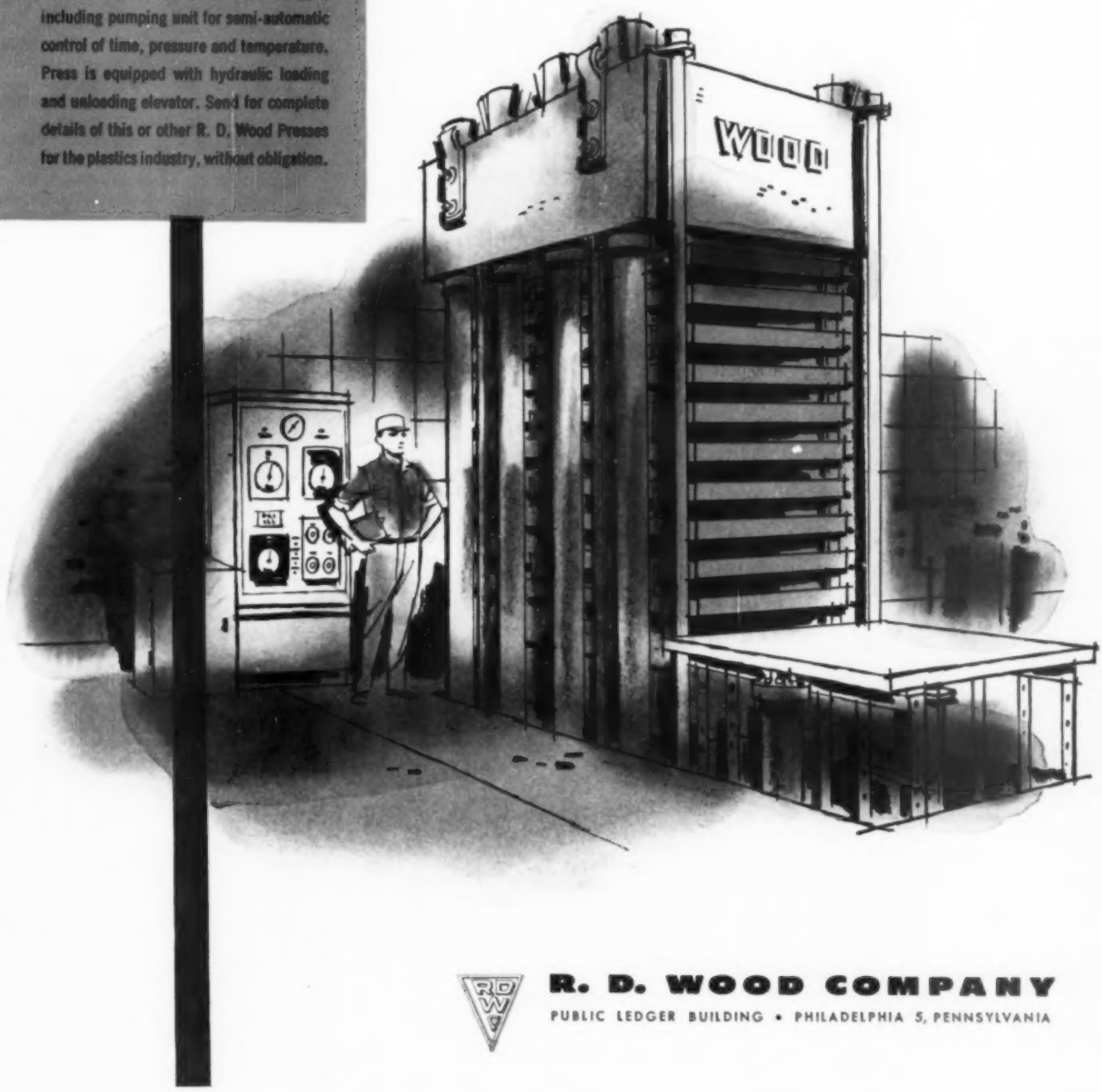

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News from Abroad

Netherlands Trade in 1957

The Netherlands was another country reporting improved business in the plastics industry during 1957. According to a study in "Plastica," the country still has to import a considerable quantity of raw materials for the manufacture of plastics and semi-finished goods, especially more expensive types. Although total exports showed a gratifying increase of 5,800 tons or 26.7% over the preceding year, imports rose by 8,500 tons or 25.6%. However, a comparison of the respective values of imports and exports for the two years reveals a more favorable trend for the balance of trade in Holland's plastics industry, with the figure for imports up by 18%, and that for exports 30.4% higher. The following table gives the quantity and values of Netherlands plastic imports and exports from 1950 to 1957 inclusive, as well as the value of exports as percentages of import values.

	Imports		Exports		Export Value, Percent of
Year	1,000-Kg.	1,000-Gld.	1,000-Kg.	1,000-Gld.	Import Value
1950	7,800	23,700	5,700	11,800	50
1951	6,100	43,100	6,700	18,800	44
1952	8,900	33,300	5,200	14,500	43
1953	13,800	44,900	9,100	24,200	54
1954	19,300	61,600	14,000	35,600	58
1955	25,600	78,300	16,900	46,700	60
1956	33,000	97,900	21,800	55,000	56
1957	41,500	115,600	27,600	71,700	62

Japanese Plastic Rocket

A foreign press report stated that, on February 12, 1958, Japan for the first time anywhere tested a rocket made entirely of plastics, except for metallic rudders. The rocket was 60 centimers long, and weighed about 35 kilograms. It attained a speed equal to three times that of sound, and reached an altitude of 2,550 meters in a flight duration of 40 seconds.

Progress in Japan

The possibilities of polypropylene are receiving a good deal of attention by certain Japanese chemical and plastics concerns which see in it a potent threat to polyethylene on account of its properties, but more particularly because of its lower cost of production. The Nissan Chemical company has been negotiating with Montecatini for technical cooperation in the production of Moplen in Japan, it is learned. If the deal goes through, Nissan will build a plant at Tokuyama, Shikoku Island, where the necessary waste gas required in the process will be supplied by Idemitsu Kosan Co. A plant capacity of 5,000-10,000 tons a year seems to be contemplated. So far, talks have not extended to polypropylene fiber, which has a special attraction for Japanese industrialists because it is expected to be the cheapest synthetic fiber made.

A rumor, so far unconfirmed, has it that Nihon Petroleum Chemistry also is interested in the manufacture of polypropylene. No details have been given as to the process likely to be used, yet plans for annual production of 16,300 tons has been implied.

A third Japanese company, Toyo Rayon Co., is said to be pushing its own research on polypropylene fiber.

Various companies are conducting investigations in other directions. Mitsubishi Kosei Chemical Co. reportedly has begun to manufacture experimentally two new copolymers: methyl vinyl ether/maleic anhydride; and methyl vinyl ether/cyclopentadiene.

The Nagashima Paint Co. began commercial output of a low-temperature curing epoxypolyamide coating material. The new product, claimed to have high chemical resistance, is to be marketed as Sun Coat No. 503.

Huls Polyethylene Plant

A plant for the production of low-pressure Ziegler polyethylene is to be built by the Chemische Werke Huls A. G., Marl, Germany. The plant, expected to begin operating in 1959, will manufacture various types of Vestolen, as the material is called, and, at the same time, is to be designed to permit considerable expansion in the initial capacity of 500 tons monthly as quickly as possible.

Huls was the last German firm to obtain Ziegler licenses; it began research in Ziegler chemistry more than two years ago, collaborating closely with Hibernia A. G., of Gladbeck-Zweckel, which had been carrying out its own investigations on Ziegler low-pressure polymerization. Both concerns set up pilot plants, with Huls undertaking development work on the products of both firms. Now, it is learned that Huls also will take charge of sales and the advisory service for the low-pressure polythene coming from the new plant to be built by the Scholven A. G., Gelsenkirchen-Buer, a subsidiary of Hibernia. The first stage of the Scholven installation is scheduled to be completed by the end of 1958, when production at the rate of about 6,000 tons annually is to commence. Hibernia will supply the necessary ethylene, as well as technical know-how.

The Chemische Werke Huls has acquired other licenses in the field of Ziegler chemistry and is actively pursuing research on other polyolefins; indeed, work on polypropylene is said to have progressed to the stage where sample quantities shortly will become available.

Europak Exhibition, 1959

Europak 1959, the Fifth Netherlands Packaging Exhibition, is to be held in Amsterdam April 21-29, 1959, when the newest packaging machines and materials from all parts of the world are to be on view. Lectures are planned on prepackaging of perishable foods, especially fruits and vegetables, and films and samples will be shown. Study groups are to be invited and an information center arranged.

The Netherlands Packaging exhibitions have been held in alternate years since 1951, and have become the largest of their kind in Europe. Accordingly, it has been decided to give the coming exhibition the name of Europak 1959.

New Polish PVC Plant

From various reports that have appeared in the European press, it is gathered that an establishment that took three years to complete started producing PVC on a pilot-plant scale in Ausschwitz, Poland, in the fall of 1957. Annual output this year is expected to reach 6,000 tons, which would just cover Poland's yearly consumption of PVC (all of this hitherto had to be imported). Further additions to this plant are on the schedule which aims at achieving an annual output of 13,000 tons by 1960.

New Materials

Write item numbers on Readers' Service Card to obtain more information.

Hot-Melt Adhesive

A hot-melt adhesive, particularly suitable for holding parts together during assembly, has been developed by Raybestos-Manhattan, Inc. Designated Ray-Bond R-84001, the material provides instant grab upon contact with glass, etched Teflon, Mylar, polystyrene, polyethylene, and almost any other material.

Recommended mainly for non-structural applications where temperatures do not exceed 150° F., the material is composed entirely of solids and is supplied in a semi-brittle state. Two methods of application are recommended: the adhesive may be heated to its melting point, 250° F., applied to one of the parts to be bonded, and immediately placed in contact with its mating member; the second method, particularly effective with Mylar, permits the adhesive to cool after application. When ready for use, the coated part is placed against its mate, and a hot iron is applied to melt the adhesive. Bond is immediately obtained upon solidification which, in turn, depends on the ambient temperature and the temperature of the work. A one-inch overlapped, Mylar-to-Mylar bond resisted a dead-load test of up to 40 pounds at 73° F.

Readers' Service Item M-1

Epoxy Resin Curing Agent

A saturated acid anhydride, methyl succinic anhydride, has been introduced by Chas. Pfizer & Co., as a curing agent for liquid epoxy resins used in casting and laminating. A low molecular weight solid, its low melting point (37° C.) permits its mixing at room temperature or slightly higher.

Testing to date would indicate that it lengthens the storage life of aliphatic or aromatic epoxy formulations and, with the addition of 1% dimethylbanzylamine, can increase the pot life to 190 hours. With a commercial diglycidal ether of bisphenol A having an epoxy equivalent of 200, 57 parts of methyl succinic anhydride are added per 100 parts resin to obtain a stoichiometric ratio. Less curing agent is required, than with other liquid or low-melting anhydride curing agents.

Methyl succinic anhydride is expected to find application where clarity, light color, long pot life, ease of handling, and moderate heat distortion temperatures are required. Physical properties are reported as follows:

Molecular weight	114.1
Boiling point, °C.	244-248
Specific gravity	1.2303
Heat of combustion, constant volume, kg.-cal./mole	527.7
Heat of hydrolysis, kg.-cal/mole	21

Readers' Service Item M-2

Polymerization Catalyst

A vinyl-type polymerization catalyst, p-menthane hydroperoxide, has been added to the product line of Wallace & Tiernan, Inc.'s Lucidol Division. The material is a stable, non-volatile liquid, and can be used at low or room temperatures by the incorporation of metallic or amine promoters in the resin formulation.

S.P.I. tests, using general purpose polyester resins, revealed low and high peak exotherms at 180 and 240° F. respectively. The catalyst may be used in conjunction with benzoyl peroxide or methyl ethyl ketone at the higher temperatures, and is generally unaffected by the presence of modifying or reinforcing agents in polyester or styrene systems.

A colorless to pale yellow-liquid, p-menthane hydroperoxide has a mild turpentine-like odor. It is relatively non-corrosive and glass, stainless steel, aluminum, nickel, or black iron containers are suitable for its storage. Temperatures in the storage area should be less than 100° F., and exposure to open flame, heat, or sparks must be avoided. Other characteristics include:

Specific Gravity, 25° C.	0.93
Refractive index, 25° C.	1.46
Flash point, (Cleveland open cup), ° C.	66

Solubility tests at 20° C. indicate the material to be insoluble in water or glycerine; slightly soluble in ethylene glycol; and very soluble in alcohols, esters, ethers, ketones, and aliphatic, aromatic, or chlorinated hydrocarbons. While the physiological properties of p-menthane hydroperoxide have not been fully determined, care should be exercised in handling this product. It should not be allowed to remain in contact with the skin, and inhalation of the vapors or contact with the eyes should be avoided.

Readers' Service Item M-3

Water-Soluble Melamine

An unplasticized melamine-formaldehyde resin solution, tradenamed Melamine 3580, has been developed by Reichhold Chemicals, Inc. The resin has met all quality requirements for surface overlays, and in application is generally diluted to the same solids content as is used for powdered resins. Treater settings remain the same, although machine variations may require some changes to obtain the required resin, flow, and volatiles.

A clear to slightly cloudy solution, requiring storage at 70-90° F., Melamine 3580 conforms to the following specifications:

Non-volatile solids Content, %	53-57
Solvent	Water
Specific gravity	1.230-1.240
Water miscibility, 25° C., %	170-250
pH	8.6-9.2
Viscosity, 25° C., cps.	50-125

Readers Service Item M-4

Fibre Glass Fabrics

A line of boat and tooling fabrics, known as the Trevarno Wetfast K series, has been placed on the market by Coast Mfg. & Supply Co. Available in standard widths up to 72 inches, the fabrics feature a parallel-fibre construction that reportedly gives faster wet-out; a strength increase up to 25%; and prevents weave patterns from showing on the product surface. The series includes K-600, K-750, K-980, and K-2500, weighing six, 7½, 10, and 25 pounds per square yard, respectively. Strength characteristics of a 0.125-inch thick K-750 laminate, are tabulated as follows:

Compressive strength, psi.:	
Dry	47,000
Wet	36,000
Tensile strength, psi.: Dry	59,000
Wet	56,000
Flexural strength, psi.: Dry	59,000
Wet	48,000
Flexural modulus Dry	3.3
Wet	3.0

Readers' Service Item M-5

Modified Alkyds For Waxes

Self-polishing floor waxes that do not water-spot can be produced by the substitution, in place of shellac, of one of two alkali-dispersible modified alkyds, developed by Reichhold Chemicals, Inc. The resins, tradenamed Waterez 1550 and 1551, are produced by the esterification of phthalic anhydride with polyols. They are hard, friable, similar in appearance to shellac, and almost water-white in color.

In the manufacture of floor polish, these normally water-impervious resins are cut with ammonia to make them disperse in water and emulsified wax components. When the polish is put down, the ammonia and water evaporate leaving a water-impervious film. Unlike shellac, which is hygroscopic and tends to polymerize or oxidize into a difficult-to-remove mass, the Waterez resins retain their original properties and can be removed easily with detergent and water.

Wax and polymer emulsions with improved dispersibility and stability, as well as a decrease in particle size can be obtained by using small percentages of wetting and emulsifying agents. Lauric, stearic, oleic acids, as well as Aerosol OT, are among the anionic additives which can be successfully used. Non-ionic emulsifiers, such as polyoxethylene derivatives, are even more effective. Surfactants can be used to decrease pH sensitivity, since Waterez solutions tend to become unstable at pH values greater than nine.

The resins are good film formers and possibly can be used with styrene-based latices for the manufacture of waxless floor polishes. Their intrinsic hardness and freedom from tack also suggest their combination with the softer, acrylic type latices. Both 1550 and 1551 are available in the form of white powders packed in 50-pound bags. They show excellent stability and freedom from blocking during storage at temperatures below 75° F., and relative humidity under 75%.

Readers' Service Item M-6

Polyester Foam Resin

Rigid urethane foams for heat insulation and soundproofing can be prepared with Dulux R-42, a polyester resin developed by E. I. du Pont de Nemours & Co. This material can be foamed in place, and will adhere to metals and plastics to form an integral part of the structure. Low-density formulations can be applied at a cost of less than six cents per board foot.

While both one-shot and semi-prepolymer formulations can be compounded with Dulux R-42, the latter method appears to provide slightly better control, more closed cells, and a more uniform cell structure. Foams prepared by either technique will achieve their maximum physical properties after aging six to eight days at room temperature. They may be cured also in two to three hours at 70° C., but room temperature curing minimizes shrinkage. Some physical properties of foams prepared by the semi-prepolymer method are tabulated as follows:

Density, lbs./cu.ft.	2	5
Closed cells, %	85-90	90-92
Tensile strength, psi	75-85	200
Compressive strength, yield point, psi	22-32	110-130
Moisture vapor permeability, perms	4	
Water absorption, 48 hours under 8-foot head, lb./cu.ft.	2.2	1.9
Thermal conductivity, K-value	0.23-0.30	0.25-0.35

When cured, the foams retain good physical properties at temperatures up to 225° F. They burn slowly when in contact with flame and will support combustion. Although non-flammability characteristics can be imparted in compounding, a sacrifice in properties must be expected. The resin itself is non-toxic, and is manufactured to the following specifications:

Solids, %	100	
Viscosity, 77° F., cps	12,000-18,000	
Acid number, max.	3.0	
Color, Gardener 1933, max.	15.0	
Specific gravity, 76° F.	1.018	0.005
Clarity	clear	
Hydroxyl number*	355	10
Water, %, max.	0.2	

*Corrected for acid number.

Readers' Service Item M-7

VANSTAY®

Vinyl heat and light stabilizers

Our trade mark of 12 years standing came into being with VANSTAY L, the first nontoxic light stabilizer for Vinyls.

Today, the VANSTAY line includes a number of materials developed to keep pace with Industry's demands for higher temperature Vinyl protection in process and in service.

Expanded research and technical service can be of immediate assistance in solving your Vinyl stabilization problems.

R. T. Vanderbilt Co., Inc.

230 PARK AVENUE · NEW YORK 17, N. Y.

Stress test of **vinyl plasticizers** shows

less polystyrene crazing with Eastman Polymeric Plasticizer NP-10

Crazing and staining of polystyrene surfaces in contact with compounded polyvinyl chloride can be virtually eliminated by using Eastman Polymeric Plasticizer NP-10.

In the test illustrated above carefully molded and cured polystyrene strips were subjected to external stress on an elliptical clamp. To magnify the effect on polystyrene resulting from its contact with plasticized vinyl compound, various plasticizers were poured directly on the strips and allowed to remain for 24 hours, or until fracture occurred.

The photograph shows the results and pointedly illustrates the relative inertness of Eastman Polymeric Plasticizer NP-10 on polystyrene surfaces.

Polymeric Plasticizer NP-10 exhibits permanence characteristics equal or superior to those of high-molecular-weight plasticizers, yet, being itself a compound of moderate molecular weight, blends in easily and rapidly. It is highly resistant to hydrolysis. Its loss from vinyl films to hydrocarbons, soapy water and activated charcoal is extremely low. It is odorless, tasteless, colorless, non-toxic and provides good low-temperature flexibility.

Eastman Polymeric Plasticizer NP-10 is an ideal primary plasticizer for vinyl applications such as refrigerator door gaskets, automotive trim... or wherever maximum permanence is essential.

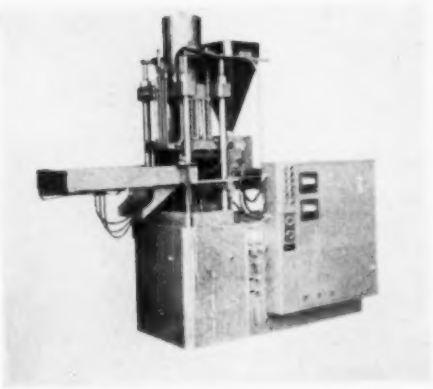
Eastman CHEMICAL PRODUCTS, INC., KINGSPORT, TENNESSEE, subsidiary of Eastman Kodak Company

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Massachusetts; Cincinnati; Cleveland; Chicago; Houston; St. Louis. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

New Equipment

Write item numbers on Readers' Service Card to obtain more information.

Automatic Molding Presses



Stokes Automatic Molding Press

A completely redesigned series of its Model 741 fully-automatic compression molding machines has been introduced by F. J. Stokes Corp. Available in capacities of 50, 75, 125, and 200 tons, the presses are equipped with automatic breathe; loading-board feed direct from hopper; and controlled vibration.

Bottom or top ejection can be achieved with a selector switch which, in addition, controls fully automatic, single-cycle, or manually controlled operation. A simple modification can provide a side-draw action, and flanged parts can be molded automatically using split cavity molds. The unit also is equipped with a standard attachment permitting the use of rope-type polyester materials with dies of any cavity layout.

Pre-set feed boards, matched to a particular mold, are supplied as part of the initial tooling for each job. They require only a volume adjustment before actual use. The operator need not modify the feed settings when the mold is changed, therefore, a complete changeover can be accomplished with in five minutes. The system can be arranged to give optimum distribution of the material throughout the cavity, and any feed tube can be blocked off without affecting other cavities in the die. Uniformity of fill permits the production of consistently uniform parts having minimum flash.

Both top and bottom ejection knockout systems are equally effective, and a solid cover plate beneath the comb prevents the top ejected parts from falling into the cavities. After stripping, the feed board pushes the comb back toward the discharge hopper and the ejected parts are wiped mechanically from the lower comb by the front of its housing.

All press movements are controlled automatically by interlocks so that they will occur in the proper sequence. Electrical and hydraulic circuits are built to J.I.C. standards. Hydraulic valves are panel-mounted on the front of the machine, and every step in the molding cycle can be adjusted from this point. Hydraulic line temperature is kept constant by an automatic cooling water flow-control.

Model 741, in its various capacities, conforms to the following specifications:

Press capacity, tons	50	75	125	200
stroke, in.	12	12	14	16
Ejection stroke, in.:				
Top	2½	2½	3	4
Bottom	3⅞	3⅞	4⅞	6
Ejection pressure, tons:				
Top	3	3	5	10
Bottom	5	5	12	20
Daylight opening, in.:				
Open	28	28	32	38
Closed	16	16	18	22
Platen dim., in.	15 x 13	15 x 13	24 x 20	30 x 24
Press cycle time, sec.:				
(8-in. stroke)	8	8	10	11
Main ram speed, in./min.:				
Closing/Opening	300	300	400	400
Intermediate	140	140	72	72
Pressing, (adjustable)	27	27	22	22
Time for 8-inch stroke, sec.	2.1	2.1	2.7	3.2

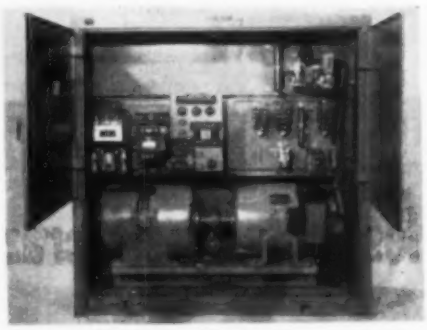
Readers' Service Item E-1

Improved Speed Variators

A line of packaged speed variators, incorporating a newly-designed static exciter and amplistat regulator with silicon rectifiers, has been placed on the market by General Electric Co. Designed for use in continuous process applications where fine speed regulation is desired, the units are available in ratings from 3-150 hp., and in speed ranges up to 200:1.

The complete package includes a d.c. drive-motor, with a low-inertia armature; a power unit, containing controls, motor-generator set, exciter, and regulator; and an operator's control panel. Terminal boards are arranged for maximum accessibility; wiring is color-coded; wire troughs are recessed; and power units, which are contained in a cabinet, can be mounted end-to-end, end-to-wall, or in positions where more than one surface must be blocked without impairing ease of maintenance.

Both the static exciter and the voltage regulator incorporate a silicon rectifier having a high-operating efficiency and requiring no warm-up period. The Model AVT-1 regulator, which is provided with the basic speed variator, gives linear, acceleration and deceleration without the use of timing relays or motor-operated rheostats. The circuit design incorporates a "linearizer" which reportedly eliminates the problems of generator field saturation and provides simple, predictable operation with uniform response from the speed-control rheostat. Other amplistat regulators are available in single-field, constant-torque; and in two-field, constant-torque, constant-horsepower types. There are other higher gain regulators for special uses, and amplidyne regulators for rapid reversing applications.

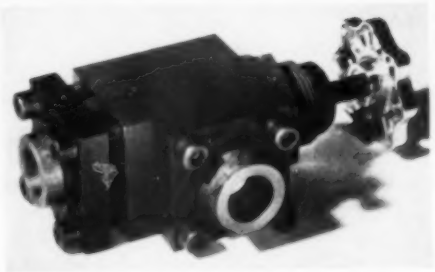


Front view of GE's speed variator showing motor generator set, and control components of the new line.

Readers' Service Item E-2

Precision Throttling Valves

A new series of precision throttling valves has been developed by Greer Hydraulics, Inc. In addition to precision control, these valves have low torque, high efficiency, long life, self-aligning seats, and light weight by virtue of an all-aluminum



Greer Throttling Valve

body. A variety of port sizes can be accomplished with only two basic body configurations; angle and through-type bodies. Valve seat replacement can be accomplished without removing the valve body from the line and, if necessary, the valve body can be removed without breaking the line.

Designed for use with oils and other liquids compatible with aluminum and steel in hydraulic systems, test equipment, etc., the valves are available with female pipe threads, female brazed tube fittings, and J.I.C. threaded parts. Easy to maintain, the valves use standard O-ring seals, and have integral valve stems and poppets of steel, and a hardened steel valve seat to provide long life at the point of contact.

The new valves are available with 1¼-, 1½-, and 2-inch ported flanges adaptable to one basic body size, and ¼-, ⅜-, ½-, ¾-, and 1-inch ported flanges adaptable to another basic body size. The two sizes can accomplish 208 and 400 combinations of porting respectively. The valves can be provided in other materials to meet special individual requirements. Valve length ranges from 5½ inches for the right-angle style, to $5^{11}/_{16}$ inches for the straight-through model. Valve bodies are two-inches square.

Readers' Service Item E-3

Rotary Vacuum Former

A recently-developed vacuum forming machine having a double platen molding station, which permits fabrication of deep-drawn products by male assist on snap-back forming operations, has been added to the Rotary-Vac line marketed by Comet Industries. Designated Model R-4872, the machine is said to give high production yields on thermoplastic products fabricated from heavier gages of plastic sheeting such as concrete forms, refrigerator liners, vending machine components, large tanks, and containers.

The machine requires three stages to complete operation. The operator remains at one station where a finished form is unloaded and the clamp-frame reloaded with a plastic sheet. After loading, the operator places his hands on two safety switches to close the clamp-frame. The carriage

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Results are accurate and reliable and can be reproduced precisely over and over again. The Weather-Ometer furnishes a yard stick to measure the improved quality of a plastic in development and to maintain a standard of quality in production.
Automatic control of light, moisture, and temperature, can be set for repeating cycles according to the test program selected. A year of destructive weathering can be reduced to a few weeks of testing in the Weather-Ometer.

For Color Fastness only — use the Atlas Fade-Ometer®. Fully automatic in operation.

Write for technical information and recommendations for your particular problem.

ATLAS ELECTRIC DEVICES CO., 4114 N. Ravenswood Ave., Chicago 13, Illinois

Comet Industries' newly-introduced model R-4872 vacuum forming machine.

automatically moves to the heating stage, the heated sheet enters the forming stage, and the finished product returns to the operator.

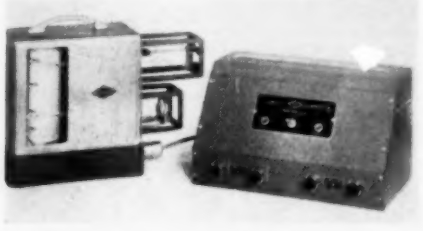
The molding station consists of upper and lower counteracting platens having a 20-inch stroke. Each platen is independently controlled, may be switched out of operation; time-returned before completion of cycle; and is capable of supplying air pressure for blow molding, pressure, and vacuum forming operations. Sheet forming combinations available on double platen equipment include vacuum and drape forming; inverted vacuum drape forming; snap-back; billow forming; male assist; punch and ring; and pressure and blow molding. The enclosed heating station houses two banks of heaters; the upper one being 10-inches from the sheet, while the lower is 20-inches. This arrangement results in shorter heating cycles.

Other features of this model include: floor space, 16½-ft. diameter; height, 86 inches; weight, 8,000 pounds; mold size, 48 by 72 inches; sheet size, 50 by 74 inches; drape stroke, bottom and top, 17-20 inches; lift force, 2,400 pounds; travel time, bottom and top, 1.8-2 seconds; and motor characteristics, 440 volts, three-phase, 60 cycle.

Readers' Service Item E-4

Humidity-Temperature Monitor

A humidity-temperature recorder and controller for measuring relative humidities between 15-95% over a temperature range of 32-130° F., is available from Serdex, Inc. Humidity variations are measured by a circular, animal membrane to an accuracy of ±3%; while a bi-metal, cantilever sensing element gives temperature readings between 0-100° F., to an accuracy of ±1°.



Humidity-temperature controller and recorder.

The unit is composed of two separately housed sections containing, respectively, the sensing and recording elements, and the monitoring circuitry. Direct readings of the recorded conditions can be obtained through an indicator window in the sensing section, where the control range is adjusted by electrical contact blocks located on a positioning post.

If one of the recording pens contacts a limit block, a relay is energized, and a five-ampere control signal is generated. When operating under "within-limits" conditions, the pen-block relay circuit is opened. This circuit is electrically checked at predetermined intervals whose frequency can be adjusted between 1-27½ minutes. Switches are provided to establish conditions within control range prior to the start of automatic operation.

Designated Model HGS-HYT-1C, the unit requires a 115 volt, 60 cycle, alternating current power source. The sensing section measures 12 by 15 by 6 inches; while the monitoring section measures 8 by 8 by 14 inches. Total weight of this model is 25 pounds.

Readers' Service Item E-5

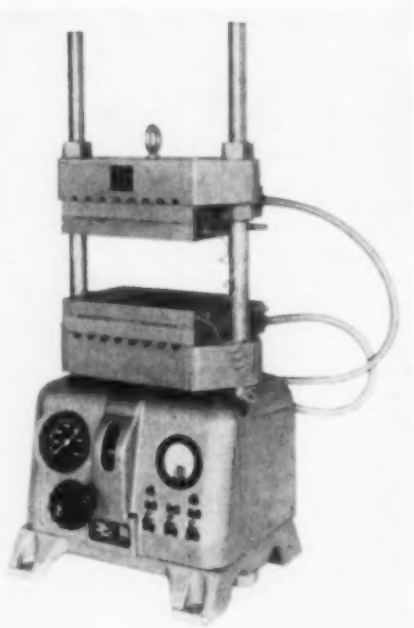
Grieve-Hendry Model LO-200-C drying oven.

Laboratory Drying Oven

A low cost, constant-temperature, laboratory oven, designated Model LO-200-C, has been introduced by Grieve-Hendry Co., Inc. Constructed of welded steel and lined with asbestos, the unit is reportedly ideal for drying, baking, annealing, sterilizing, evaporating, and heat treating.

This oven has an operating temperature range up to 200° C., and features nickel-plated shelves, whose height can be adjusted in ½-inch increments; thermostat controlled, induced air circulation; red pilot light which shows heater action; concealed rubber feet; explosion-proof door latch; steam thermometer; and a six-foot cord with plug. Inside dimensions in inches are: width, 12; depth and height, 10.

Readers' Service Item E-6



Wabash 12-10N laboratory-size press.

Hydraulic Laboratory Press

A laboratory-size hydraulic press, capable of exerting pressures up to 12-tons, is available from Wabash Metal Products Co. Designated Model 12-10N, the unit incorporates a manually-operated hydraulic ram having a 20% overload factor. Pressure can be increased in small or large increments as desired.

Platens measure seven by 10 inches, are electrically heated, and draw a total of 2,000 watts. A thermostat gives temperature control from 100-600° F., with a differential of ±2° F. A pyrometer is thermocoupled to the platens and permits reading the temperature of each by the flick of a switch.

The unit has two, 1½-inch diameter columns separated by a distance of 11 inches. Platen stroke is six inches, and maximum daylight opening is adjustable to 15 inches. The pressure gage is calibrated in pounds per square inch, and in total force on the ram diameter. Platen supports are vented for cooling, and controls are located on the base away from the heated zone. The unit is wired for connection to a 115 or 230 volt, a.c., power source. Over-all dimensions in inches are: base area, 10½ by 15; height, 36.

Readers' Service Item E-7

Plastics Applications

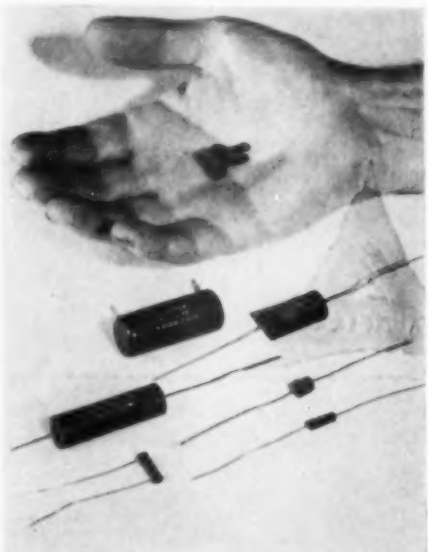
Write item numbers on Readers' Service Card to obtain more information.

Alkyd Resistor Cores

Wire wound resistors, possessing a high degree of dimensional stability and available in resistance values from one ohm to 20 megohms, are being produced by Ultranix, Inc. The units are recommended for missile, aircraft, and computer applications where close tolerances must be maintained under adverse environmental conditions.

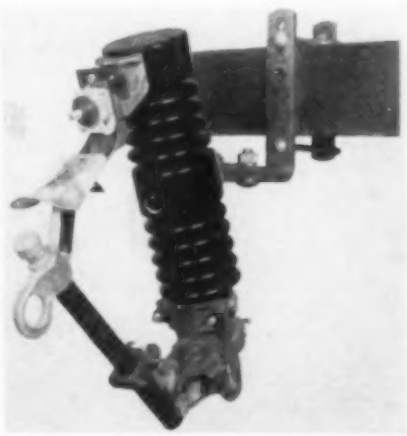
Multiple pi-reversed windings, substantially non-inductive up to 50 kc., are wound on bobbins made of Allied Chemical Corp.'s Alkyd #417 putty. The bobbins are compression molded with external leads in place to assure firm anchorage. Alkyd #417 putty also is used to encapsulate the resistor. Since this material has a coefficient of linear expansion matching that of the resistance wire, frictional strains and their resultant complications are eliminated. In addition the resin is said to have superior moisture absorption an dthermal conductivity properties.

Ultranix resistors exceed the requirements of MIL-R-93A and MIL-R-9444. Tolerance specifications as low as ±0.01% can be held even at very low resistance values. The units have an operating temperature range from —65 to +125° C., and are available with temperature coefficients as low as —15 ppm., or as great as 0.45% per degree temperature variation.



Ultranix alkyd resin encapsulated resistors.

Readers' Service Item P-1



G-E's reinforced plastic fuse holder.

Plastic Fuse Link Holder

Extra heavy duty cutouts with twice the interrupting capacity of existing units are currently available from General Electric Co.'s distribution transformer department or from Canadian G-E. Actual new item is the fuse holder, which is made from glass-reinforced polyester resin and has expandable cap action.

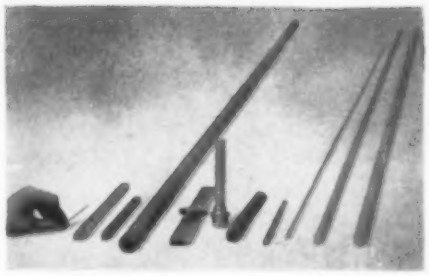
Under low fault currents, gases are expelled downward; under high fault currents, the gases are vented both down and up. These fuse holders are interchangeable with previous models, and can be used in many existing G-E open cutout frames.

The completely new design of the fuse holder enables the 7.8 KV cutouts to be boosted from 5,000-10,000 amps, and the 15 KV line from 4,000-8,000 amps rated interrupting capacity at 60 cycles. These new ratings are expected to make possible a wider application of cutouts on distribution systems, while allowing for future system growth.

Readers' Service Item P-2

Epoxy & Silicone Structures

Seamless, glass-reinforced epoxy and silicone structures have been placed on the market by Chemfab Corp., under the trade name Chemtube. Available in other than tubular forms, these materials find application as aircraft electronic fuel gages, rigid conduits for corrosives, in printed circuitry, waveguides, transformer cores, condenser sheaths, coil forms, electronic potting, and both hydraulic and pneumatic systems.



Glass-reinforced epoxy and silicone structures.

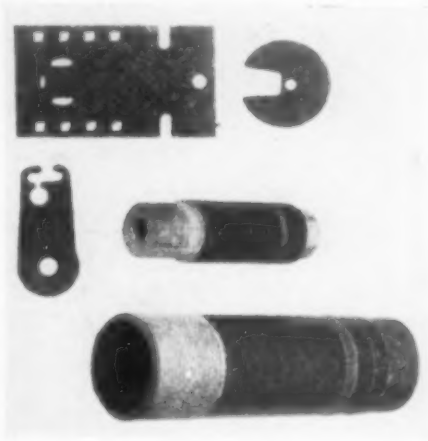
Among the features offered by these materials are high mechanical and dielectric strength at sub-zero and elevated temperatures, and dimensional tolerances of one mil. Chemtube utilizes continuous, tubular reinforcement of glass fiber, custom braided to specified stress requirements. Strong walls, as thin as 15 mils, are possible without steps, seams, or joints.

Impregnant for the epoxy Chemtubes is a high-temperature Epoxy-CL system which can operate at —320 to +400° F. Other properties include: dielectric strength, 500V/mil thickness; compressive strength, 22,000 psi.; tensile strength (tube), 22,200 psi.; and flexural strength (fiber stress), > 32,000 psi. The silicone structures have a service temperature up to 392° F.

Readers' Service Item P-3

Heat Resistant Laminates

A high-heat-resistant laminate, said to retain its mechanical properties after momentary exposure to temperatures as high as 3,500° F., has been developed by Continental-Diamond Fibre Corp. Tradenamed Dilecto, the laminate is made from felted asbestos, impregnated with a heat



Dilecto laminates in the upper left have been cold punched by standard methods; while the molded tubing has been threaded and counterbored with conventional equipment.

Have something to say about the raw materials used in your plasticizers

Phthalate-type plasticizers—DIOA, DDP, DDA, DIOP—made from Amoco Oxo Alcohols are lighter in color and more stable. This is possible because with these Alcohols, esterifiers are starting with the highest quality raw materials. How come? Because Amoco Oxo Alcohols must meet specifications that are setting a new industry level for minimum ester color.

Getting better finished vinyls and improving processing can result from checking the quality of the raw materials used in plasticizers that you buy.

AMOCO CHEMICALS

AMOCO CHEMICALS CORPORATION
910 South Michigan Ave., Chicago 80, Illinois

resistant phenolic varnish.

In one industrial application, Dilecto laminates are subjected to continuous operation at 500° F., with intermittent jumps to 900° F., without showing any thermal or mechanical property loss. In dry and wet heat tests at temperatures from 300-350° F., only negligible dimensional and mechanical changes were noted. Other tests have shown retention of dry properties after a 2-hour immersion in boiling water, with similar results from a 30-day immersion in water at room temperature.

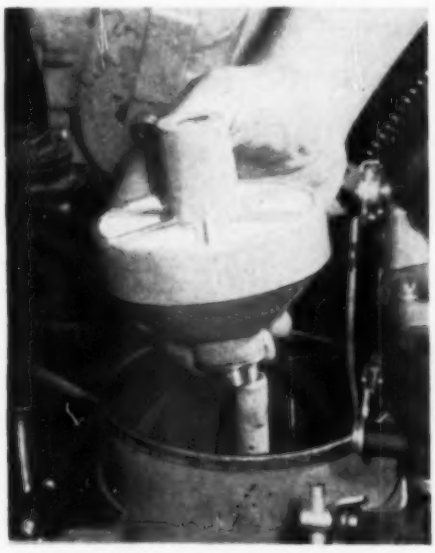
While showing great promise as a thermal insulator, the laminate exhibits no more than average electrical insulating properties when compared to electrical grade types. A short-time dielectric strength of 160 vibrations per minute was found in some preliminary tests on material thicknesses of 0.045-inch. Arc resistance tests on the same piece indicated resistance up to 190 seconds.

Available in the form of sheets, molded tubes, and rods; Dilecto laminates are expected to provide a solution to many structural heat problems encountered in the design of jet engines and missile parts. They can be fabricated by conventional methods such as sawing, tapping, milling, countersinking, or boring; and thicknesses up to 1/16-inch have been cold-punched by standard methods.

Readers' Service Item P-4

Butyrate Oil-Filter Cartridge

An automotive oil-filter cartridge, which capitalizes on the residual static electricity of its butyrate body and element retainer to retain fine settlings, has been introduced by Acme Plastics Products Co. Called the Mor-Flo, the filter has multiple traps and three settling areas, all in less space than that required for metal filters.



Mor-Flo butyrate oil filter.

Used in conjuction with a steel adaptor, the Mor-Flo can be installed in many makes of automobiles, trucks, and gas engines. This adaptability should be an asset to service station operators, who can reduce their inventory stock by eliminating a wide range of special type filters. Butyrate used for this application is Tenite, a product of Eastman Chemical Products, Inc.

Readers' Service Item P-5

Impact-styrene meat slicing tray.

Impact-Styrene Carving Tray

A carving tray which will absorb neither grease nor food odors has been introduced by Nu-Dell Mfg. Co. Called E-Z Slice, the tray is molded from high-impact styrene supplied by Catalin Corp. of America. It washes easily, and requires no scrubbing or scouring.

Meat juices drain via gutters into an extra deep gravy well at one side of the tray. Food is gripped during slicing by molded spikes, and the tray itself is secured by non-slip, non-marring legs. E-Z Slice measures 14 inches long, is nine inches wide, and has a blonde wood-grain finish.

Readers' Service Item P-6

Transparent Adhesive Tape

The new transparent adhesive tape, recently introduced by Johnson & Johnson under the trade name Band-Aid Clear Tape, is actually a clear vinyl film coated on one side with a surgical-type, pressure-sensitive adhesive. Since the tape does not reflect light, it blends with the appearance of the skin beneath and around it so as not to be noticeable.

Although stronger than other adhesive tapes, it is light, flexible, and will not bind

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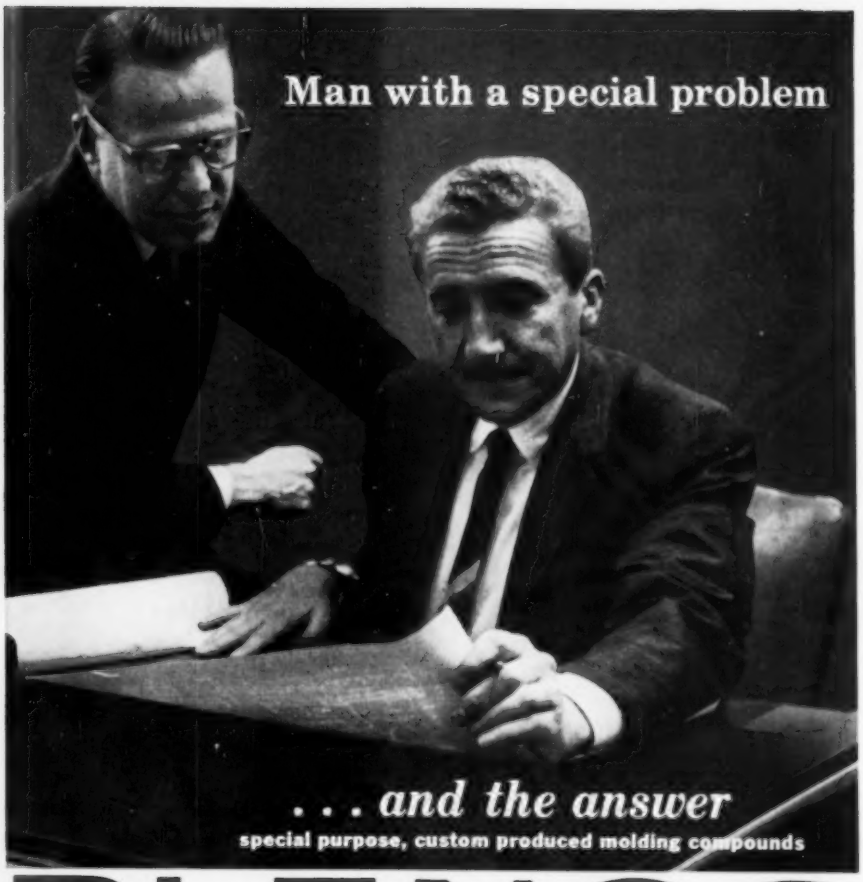

PLENCO

Here's further evidence of the way Plenco engineers have responded to the needs of manufacturers and designers. *Special* needs, in these instances, demanding special answers.

For, although the basic properties of thermosetting phenolic molding compounds were required, the standard categories available were not ideally suited. Consultation with Plenco was a natural first step. The custom-design and production of *special-purpose* compounds by Plenco was the result. Here are just a few:

- A high thermo-conductive molding compound wherein a specific thermo-conductive coefficient was needed to satisfy design requirements for the proper function of an electrical control device.
- A high impact strength compound possessing high heat resistance plus a specific coefficient of friction.
- A special compound capable of reproducing extremely fine definition with low molding pressures for the production of printing matrixes.
- Service as a special backing for diamond abrasive cutting wheels was the chief requirement of another problem-solving new compound.
- For the production of electrical components extremely sensitive to chlorides, a compound meeting (by means of water extraction tests) a maximum chloride content of not more than 3/10 parts per million.

These compounds are, of course, not stock items. They have been developed to serve specialized industries and to perform under particular conditions. They demonstrate once again that *if phenolics can do it, Plenco can provide it* . . . already made or specially made. We invite you to discuss your product or production problem with us.

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Sheboygan, Wisconsin

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J & J's transparent Band-Aid.

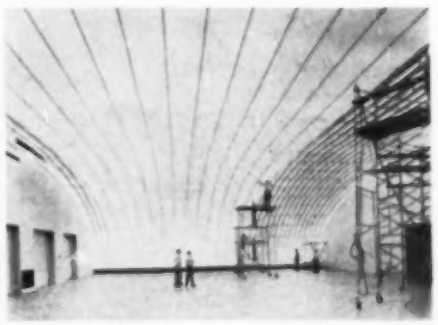
or pull. Like other plastic tapes, it is completely waterproof. Band-Aid Clear Tape is packaged in a circular blue and white transparent plastic container, with flat base for standing upright on shelves. The dispensing vent at the side is covered by a sliding panel with a plastic cutter. To extract the tape, the cover is pushed back and the desired length pulled out. The cover is snapped shut to cut the tape.

Readers' Service Item P-7

Rigid Vinyl Luminous Ceiling

Chrysler Corp.'s styling showroom in Highland Park, Mich., now features a luminous ceiling of Bakelite rigid vinyl sheets which radiate a sweeping curve of light on future automotive designs. The translucent panels are color stable and diffuse light without glare. The Wakefield Co. designed and manufactured the ceiling, following a parabolic curve to the floor at each end of the room.

The lightweight panels are held in channels of aluminum and cover white fluorescent lamps. The electrical channels were preassembled with wiring, sockets, and ballasts for the lamps. Panels are easily removed for cleaning with soap and water, and are resistant to moisture and warping. Intensity of light can be varied by switching off alternate rows of lamps, and the maximum light available at working level averages 240 foot candles.



Luminous ceiling made up of rigid vinyl sheets.

Readers' Service Item P-8

New Literature

Write item numbers on Readers' Service card to obtain copies.

"Polypenco Industrial Plastics." Polymer Corp. of Pennsylvania. 36 pages. This design file includes Bulletin BR-1, a general products brochure; a Polypenco nylon technical bulletin; and a booklet on Nylaflow pressure tubing.

Readers' Service Item L-1

"MFG for 1958." Molded Fiber Glass Boat Co. 8 pages. This four-color brochure illustrates and lists complete specifications for the firm's boat line.

Readers' Service Item L-2

"The Role of Polyethylene in Creative Packaging and Successful Selling." Bakelite Co. 16 pages. Compiled by J. R. Akers, manager for flexible packaging materials, this booklet describes dozens of ways in which polyethylene is used in successful packaging applications.

Readers' Service Item L-3

"Package Irregular Shaped Products with Amsco Packaging Equipment." Amsco Packaging Machinery Co., Inc. 4 pages. Using schematic diagrams, the brochure explains how to wrap single or double film around a product from rolls. The film ends are twisted to form a close fitting wrap. Shrink tanks are explained.

Readers' Service Item L-4

"Nauta Quick Thorough Mixing of Dry Materials." Catalog No. 382. Buflovak Equipment division, Blaw-Knox Co. 4 pages. A cross-sectional illustration is used to explain the mixer's action, which involves precessional motion of a revolving screw inside an inverted cone. Physical dimensions and capacity are listed for six models.

Readers' Service Item L-5

"Luzerne Rigid PVC Roll Covering." RC 9000. Luzerne Rubber Co. 1 page. Rigid PVC tubing is shrunk tightly over new or old rolls to provide a strong mechanical bond. Special tubes are available for shrinkage at the buyer's plant.

Readers' Service Item L-6

"Treat Polyethylene Film for Printing at Low Cost Electronically." Aetna Electronic Corp. 4 pages. A schematic diagram shows how to hook-up the firm's electrodes for treating polyethylene film. Other data on the electrodes themselves are included.

Readers' Service Item L-7

"Bronze Powders for Plastics." Hummel Chemical Co., Inc. 1 page. Descriptions and mesh sizes are listed for seven bronze powders for coloring PVC, epoxy, and polystyrene formulations. Two pastes also are available.

Readers' Service Item L-8

"Baldwin Compacting Presses." Bulletin 3107, Hamilton division, Baldwin-Lima-Hamilton Corp. 4 pages. Specifications and photographs of the Model 50W compacting press are contained in this bulletin.

Readers' Service Item L-9

"Speedi-Set Plastic Molding Compound." Tech. Bulletin 113. Duramic Products, Inc. 1 page. Procedures for making plastic molds with this single-component, thermosetting compound.

Readers' Service Item L-10

"Stanpreg A-PH." TDS-105. Standard Insulation Co. 1 page. Physical properties are listed for this heat-resistant phenolic pre-impregnated glass cloth.

Readers' Service Item L-11

"Luzerne PVC Pipe and Fittings." PF 1200. Luzerne Rubber Co. 8 pages. physical properties, chemical resistance, and specifications are listed in this bulletin.

Readers' Service Item L-12

"Hydraulic Alumina Silicates." Bulletin 1257. Summit Mining Corp. 8 pages. The firm's Microcite, Ser-X, and Ser-A-Sil hydrous alumina silicates can be used as plastics fillers. Physical properties are listed along with dehydration reactions and particle size distribution.

Readers' Service Item L-13

"Vacuum Metallizing." Catalog No. 780. F. J. Stokes Corp. 22 pages. The process is described, and many applications are illustrated in this brochure.. Specifications are listed for all current models of Stokes vacuum-metallizing, which includes units with 24-, 36-, 48-, and 60-inch diameter vacuum chambers.

Readers' Service Item L-14

"Silicones As Release Agents for Plastics Molding." AD 9-B. General Electric Silicone Products department. 4 pages. Applications, methods of application, and specific products are listed and reconciled with the plastic and fabrication method used.

Readers' Service Item L-15

"Naugatuck Plastics Condensed Catalog." Naugatuck Chemical division, U. S. Rubber Co. 8 pages. Application and property data on all plastics produced by the division are condensed in this bulletin.

Readers' Service Item L-16

"How To Obtain Automotive Molding Business." Bulletin No. 9. Fiberite Corp. 4 pages. In addition to specific suggestions on becoming an approved source, the booklet lists the firm's line of thermosetting materials used for automotive applications.

Readers' Service Item L-17

"Pfaudler Conical Dryer-Blender." Bulletin 956. Pfaudler Co. 12 pages. This bulletin explains the operation mechanics and uses of the firm's glassed-steel conical dryer-blender.

Readers' Service Item L-18

"Sulfur Dioxide." Ansul Chemical Co. 15 pages. This material is of interest in plastics as a solvent, anti-oxidant, and as a polymerizing agent. Properties and specifications are listed.

Readers' Service Item L-19

"Thermosetting Knobs." Waterbury Companies, Inc. 4 pages. This illustrated brochure contains complete diagrams and specifications of a representative selection of the company's standard plastic knobs.

Readers' Service Item L-20

"Helpful Hints On Installing Aqualoy Deck Fittings." The Danielson Mfg. Co. 8 pages. Available types of Aqualoy nylon boat fittings and methods of installation are explained in this booklet.

Readers' Service Item L-21

Book Reviews

"ASTM Standards on Electrical Insulating Materials." American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Paper, 6 by 9 inches, 692 pages. Price; $4.50 to members, $6.00 to non-members.

Prepared annually by ASTM Committee D-9 on electrical insulating materials, this book bears the issue date September, 1957. Its stated purpose is to present what the Society believes important to those interesed in elecrical insulation.

Specifications and test methods are listed for the following general categories of insulating materials: shellac and varnish; plates, sheets, tubes, rods, and molded materials; mineral oils; ceramic products fabric; papers; mica products; specialty plastic and rubber tape. All methods listed are believed to be the best available at the present time.

"1957 Supplement to Book of ASTM Standards." Part 6. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Paper, 6 by 9 inches, 440 pages. Price, $4.00 ($28.00 for entire set of 7 supplements).

The ASTM Standards book is published triennially, with the supplements coming out in intervening year. Part 6 covers plastics, electrical insulation, rubber, electronic materials, and carbon black. Included herein are 70 standards covering specifications, strength, aging, low-temperature testing, hardness, thermal properties, optical properties, analytical methods, molds and molding processes, definition, and nomenclature.

Two of the ten standards are replacements to existing standards, seven were adopted without change, and two represent tentatives revised and adopted in 1957. Yellow stickers accompanying this supplement call attention to standards and tentatives in the 1955 book, part 6; plus its 1956 supplement; wherein standards or tentatives have been superseded. These stickers should be affixed as noted.

"Engineering Materials Handbook." Edited by Charles L. Mantell. McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. Cloth, 6¼ by 9½ inches, approximately 2,000 pages. Price, $21.50.

This comprehensive reference book covers metals, inorganic materials, and organic materials from the viewpoints of engineering structures, machinery, and equipment. Included herein are engineering tables, design information, structural characteristics, and tabular data in readily available form. Emphasis is on fabricated material forms, ultimate physical and mechanical properties, advantages and limitations, and durability.

Over 150 experts have contributed to the 43 sections covered in the handbook. Plastic materials are covered in a number of sections, and Section 33 is devoted exclusively to their classification, properties, processing, and applications. Additional information is given for films, laminates, coatings, silicones, and floor coverings.

Special sections include 13 pages of abbreviations, material problems of specific industries, sources of information and bibliography, and an extremely comprehensive subject index. The book is a must for all engineers and those concerned with design, processing, structural applications, and serviceability of materials.

"Scientific Russian." James W. Perry. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6¼ by 9½ inches, 845 pages. Price $7.50.

It is certainly no secret that Rusian scientists read far more of our technical literature than we do of theirs. Over 1,400 scientific journals from the United States are received regularly in the USSR, translated immediately, and made available to technical personnel. In contrast, only a handful of Russian technical journals are received here. This does not reflect a disinterest here, however, since the John Crerar Library estimates that over 75% of all requests received are for translations of Soviet publications.

Learning to read Russian is not nearly so difficult as it may seem. Happily, the Cyrillic (Russian) letters, of which there are 32, represent only one sound per letter. Since many Russian and English scientific terms are derived from the same source, acquiring a technical vocabulary does not pose as many problems as would a general, non-technical vocabulary. This particular work starts by pointing out the similarities before going into the actual Russian grammar. Assuming one knows his own language and its grammar, he can acquire a good reading knowledge of technical Russian by self-study, using this book.

"Oxidative Degradation of Deutero-Polystyrenes." H. C. Beachell and S. P. Nemphos, University of Delaware for Wright Air Development Center. Order PB 131409 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 45 pages. Price, $1.25.

Oxidative degradation of deuterated polystyrenes was studied in the temperature range from 185-237° C. Volumetric experiments of oxygen uptake by the polymers, and infra-red spectra were used in product analysis and rate studies. All polymers gave up carbonyl compounds, with some hydroxyl and other groups forming.

Rate studies showed an activation energy of 26 kilocalories for oxygen uptake while the energy of the carbonyl formation was about 45 kilocalories. Rate of oxidation was decreased in isomers with deuterium substituted on the alpha carbon, indicating that the hydroperoxide intermediate complex forms on this carbon; and that the tertiary carbon-hydrogen bond-breaking is the rate-controlling process of the reaction. Ozonization studies on the deuterated polymer yielded similar results.

"Preparation and Characterization of a Series of Graft Copolymers." S. Axelrod, Picatinny Arsenal, U. S. Army Ordnance Corps. Order PB 131333 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 21 pages. Price, $.75.

A series of graft copolymers consisting of an alkylated polystyrene backbone with polymethyl methacrylate side chains were synthesized and characterized, each with a different proportion of p-isopropyl styrene to methyl methacrylate. Both the graft copolymers and a random copolymer, prepared as a control, were studied by viscometry, infra-red absorption spectroscopy, and elemental analysis.

"Bulk Compressibility of Polymers at Fabricating Temperatures." B. Maxwell and S. Matsuoka, Signal Corps, U.S. Army. Order PB 131334 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 25 pages. Price $.75.

After an investigation of the effect of high hydrostatic pressure on polymeric melts, it was concluded that careful consideration must be given to the bulk compressibility of the melt in designing injection molding equipment and cycles. High compressibility affects such factors as residual pressure in the mold, as well as density and mechanical properties of the molded item.

Compressibility varies in different materials; is non-linear; and in all cases is dependent on the rate of compression. In amorphous polymers, it was shown to be made up of two parts; one associated with the glassy structure, and the other with the rubbery structure. In crystalline polymers, compressibility is affected by a pressure-induced change of state.

Abstracts of Important Articles

Materials

"Styrene Oils and Alkyd Resins," M. Bottcher, *Kunststoff Rundschau*, 4, 7, 289; 4, 8, 348 (July & Aug. 1957).

Processes for the copolymerization of styrene with various oils and with alkyd or oil-modified alkyd resins are reviewed and the effects of the combinations mentioned. Special reference is had to the patents involved. (In German.)

"Graft Copolymers—Part 2," S. H. Pinner and V. Wycherley, *Plastics (London)*, 22, 243, 503 (Dec. 1957).

The methods of forming graft copolymers by high-energy irradiation reviewed are the pre-irradiation, the peroxide, and the direct methods as carried out on polyethylene. The monomers used are vinylidene chloride, styrene, methylmethacrylate, and acrylonitrile. Graphs and tables compare the deposition of acrylonitrile on polyethylene with various radiations, the relative sensitivity of methylmethacrylate and styrene under direct radiation, and the effects of the presence of oxygen during irradiation of polyethylene.

"Ziegler Type Catalysts for Polymerization Processes," E. G. Gurphey, *Brit. Plastics*, 30, 11, 486 (Nov. 1957).

The author discusses the structure of Ziegler-type catalysts, and the reaction mechanism and sterospecificity of the catalysts in some detail. The importance of binary ratios in characterizing resulting polymers and polymer properties are considered. Finally, the distinguishing features of recent patents for catalysts for polymerizing ethylene and homologs, based on the Ziegler invention, are mentioned.

"Results of Bonding Experiments on High Pressure Polyethylene," H. Peukert, *Kunststoffe*, 48, 1, 3 (Jan. 1958).

The surfaces of plastics like polyethylene require special treatment to produce the polar characteristics necessary for adhesion. In the experiments described in bonding high-pressure polyethylene to itself and to metals (for chemical apparatus) Bostik 475 proved to be the most suitable adhesive, and 10-15% by volume of Boscodur A provided the polar characteristics. Of the various mechanical and thermal methods tested to make the polyethylene surfaces wettable, heating by a flame of illuminating gas was found the best. The flame-treated surfaces showed such stability as to suggest the possibility of commercial production of semi-finished polyethylene products activated on one or both sides. (In German.)

"Detection of Wood Flour in Cured Phenolic Moldings," I. Arendt and H. J. Schenk, *Kunststoffe*, 48, 1, 23 (Jan. 1958).

Under unfavorable climatic conditions, woodflour-filled phenolic moldings have a corrosive effect. A method is described for detecting the presence of lignin in phenolic that is based on the oxidation of the resin by nitrobenzene in alkaline medium. The resin dissolves and soft woods form vanillin, while hard woods form syringic aldehyde as well. Both aldehydes can be separated by paper chromatography and identified by their R_f values and dark blue fluorescence under ultra-violet light. The method also can be used for aminoplasts. (In German.)

"Influence of Chemical Structure on the Birefringence of Macromolescular Substances," J. Majer and J. Dvorak, *Kunststoff Rundschau*, 4, 8, 345 (Aug. 1957).

A study of birefringence measured on compact block polymers and copolymers with a large modulus of elasticity (of the order of 10^4 kg./sq. cm.). It was attempted to confirm theoretically the relations found between stress birefringence, refractive index, polarizability, and contraction during polymerization. Measurements were limited mainly to optical parameters, hence results are regarded as only semi-quantitative. (In German.)

"Flow Properties and Wearing Effect of Thermosetting Molding Powders. Wear-resistance of Molding Steels and of a Chromium Layer," A. Lundborg, *Kunststoffe*, 48, 1, 16 (Jan. 1958).

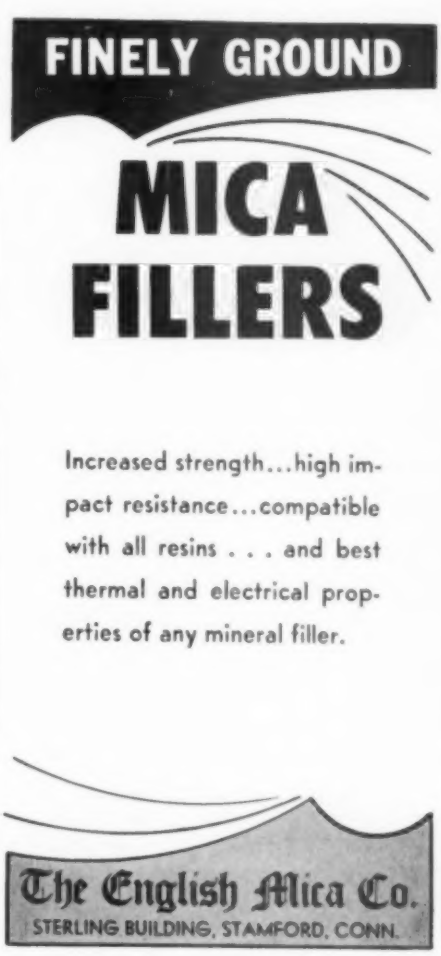
Radioactive methods were used to determine the wearing effect of phenolic, alkyd, urea, melamine and melamine compounds. It was found that the form and hardness of fillers used were more important wear factors than the filler quantity. The wear resistance of steel is greatly increased by chromium plating. It was shown that judicious selection of molding material, careful control of processing conditions, and proper choice of steel can increase mold life up to 240 times, and up to 800 times if the steel is chrome-plated. (In German.)

"On the Determination of the Water Values for Plasticizers," O. Nehring, *Plaste & Kautschuk*, 4, 7, 246 (July 1957).

Daidone's method for determining "water values" of plasticizers was studied, a modified procedure being followed. The mathematical processes by which it was attempted to find theoretical confirmation for Daidone's suggestions, as applied to tricresylphosphate and triethylhexylphosphate, are explained. The investigations are to be continued. (In German.)

"Polycarbonate Resin," R. J. Thompson and K. B. Goldblum, *Modern Plastics*, 35, 8, 131 (April 1958).

The ester exchange and phosgenation methods for manufacturing the new thermoplastic are described. Special attention is given to the material's physical, thermal, and electrical properties, and there is some mention of processing methods and potential applications.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Equipment

"Installations for 'Electro-erosive' Finishing of Injection and Compression Molds,". H. Kalpers, *Plastverarbeiter*, 8, 6, 203 (June 1957).

Details are given of machines that make direct use of electric sparking for removing unwanted metal from injection and compression molds, and for altering such molds. Included is a small, portable machine for precision work on parts with very small dimensions. (In German.)

"Special Slide Rule for Calculating the Length of Plastic Sheet on a Roll," H. Gut, *Kunststoffe*, 48, 1, 39 (Jan. 1958).

The slide rule permits rapid calculation of the length of plastic sheet 0.02-0.2 mm. thick, on new and partly-used rolls, or to assess possible damaged length. The mathematical basis of the simple device is explained, but no special mathematical knowledge is required for its use. (in German.)

"Trends in German Testing Techniques," F. Starzmann, *Brit. Plastics* 30, 11, 492 Nov. 1957).

New applications of plastics, particularly as construction materials, are given new directions to techniques for testing mechanical strength that will affect future design of testing equipment. From this standpoint, various types of tensile testers, clamping devices, recorders, methods of loading, and both low- and high-load testing are discussed critically. The author explains why the pendulum balance no longer should be used for determining load in tensile tests, and cities as a step in the right direction a Swedish device using a chain balance for measuring load in testing the strength of paper.

"Infra-red Treatment of Synthetic Fibers and Plastic-coated Fabrics," R. C. Geslin, *Ind. Plastiques Mod.*, 10, 1, 35 (Jan. 1958).

After discussing the types of infra-red transmitters used in heaters and dryers, the author considers the characteristics, performance, and energy consumption of infra-red equipment built by two French firms for (1) treating coatings of vinyl, silicone, melamine, and latex on such supports as fiberglass fabric, paper, velvet carpeting, cord and braid; and (2) hot stretching of nylon yarn and preforming nylon fabric. (In French.)

"Effective Mold Design," C. F. Pearl, *Modern Plastics*, 35, 8, 111 (April 1958).

Successful solutions to two troublesome mold design problems are discussed; the products involved were a one-piece nursing nipple and a vinyl bumper guard for a floor polisher.

"Hot Runner or Runnerless Molding," E. P. Moslo, *Plastics Ind.*, 16, 4, 24 (April 1958).

A review of the field, discussing the function of the sprue, mold temperature, mold design, and mold heating and cooling arrangements.

Processing

"Low Pressure Molding of Polyenester Resins Reinforced with Staple Fibre," B. Bossu, *Ind. Plastiques Mod.*, 9, 10, 52 (Dec. 1957).

A polyenester is a polyester having double bonds that can open up to allow more or less extensive cross-linking. The present article discusses the problems involved in low-pressure forming in which either preforms or premixes are used, and stresses the differences in the two methods. (In French.)

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. The publishers and their addresses are given below:

"Applied Plastics"
The Scientific Press, Ltd.
11 Gloucester Road
London, S.W. 7, England

"ASTM Bulletin"
American Society for Testing Materials
1916 Race St., Philadelphia 3, Pa.

"Australian Plastics"
Australian Trade Publications, Ltd.
171 Sussex St., Sydney, Australia

"British Plastics"
Iliffe & Sons, Ltd.
Dorset House, Stanford St.
London S.E.I, England

"Canadian Plastics"
341 Church St., Toronto, Ont., Canada

"Chemical and Engineering News"
1155 Sixteenth St. N.W.
Washington 6, D. C.

"Hule Mexicano y Plasticos"
Filomeno Mata 13-11, Mexico, D.F.

"Industrial and Engineering Chemistry"
1155 Sixteenth St. N.W.
Washington 6, D. C.

"Industries des Plastiques Modernes"
Les Publications Techniques Associees
40 Rue du Colisee, Paris 8e, France

"Kunststoffe"
Carl Hanser Verlag
Leonard Eck Str. 7, Munich 27,
Germany

"Kunststoff-Rundschau"
Brunke Garrels, Verlagsbuchhandlung
Borgfelder Strasse 83, Hamburg 26,
Germany

"Materials and Design Engineering"
Reinhold Publishing Corp.
430 Park Ave., New York 22, N. Y.

"Materie Plastiche"
Via Farneti 8, Milan, Italy

"Matiéres Plastiques"
Galerie du Center, Bloc 3
Rue des Fripiers, Brussels, Belgium

"Mechanical Engineering"
American Society of Mechanical Engineers
29 W. 39th St., New York 18, N. Y.

"Modern Plastics"
575 Madison Ave., New York 22, N. Y.

"Oesterreichische Plastic-Rundschau"
Ployer & Co.
Aegidiengasse 5, Vienna 6, Austria

"Plaste und Kautschuk"
Veb Verlag Technik
12 Unter den Linden
Berlin N.W.7, Germany

"Plastic"
Danish Technical Press
31 Vester Farimogsgade
Copenhagen 5, Denmark

"Plastica"
Kunststoffeninstituut T.N.O.
Julianalaan 134, Delft, The Netherlands

"Plastics"
Temple Press, Ltd.
Bowling Green Lane, London E.C.1,
England

"Plastics World"
Cleworth Publishing Co., Inc.
1 River Road, Cos Cob, Conn.

"Plastiques Informations"
94 Rue Saint-Lazare
Paris 9e, France

"Plastverarbeiter"
Verlagsgec. m.b.H.
Herxheim b. Landau/Pfalz, Germany

"Poliplasti"
E.T.A.S., Via Andrea Mantegna 6,
Milan, Italy

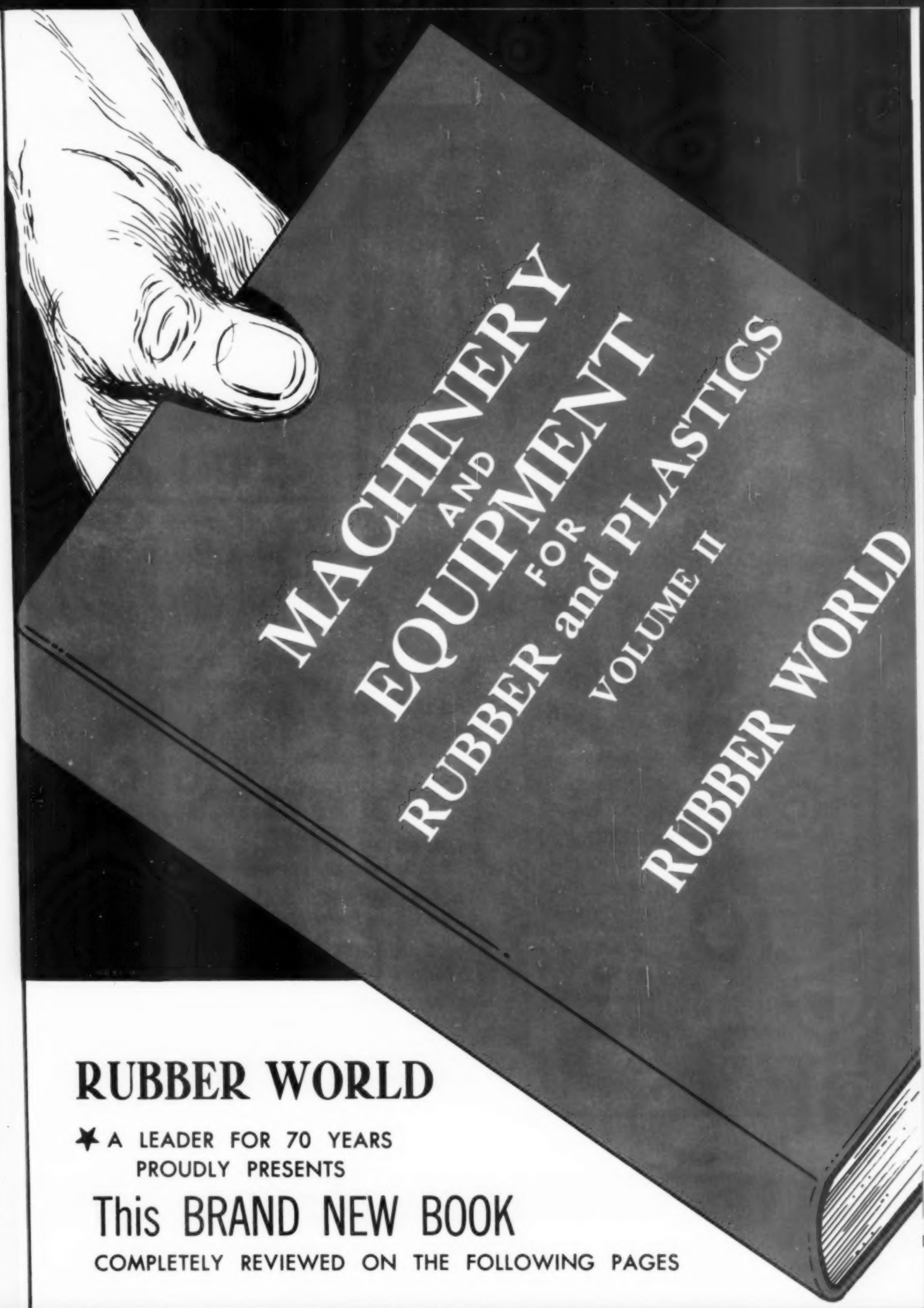
"Revista de Plasticos"
Inst. "Alonso Barba"
Serrano 119, Madrid, Spain

"Revue Générale des Matiéres Plastiques"
196 Ave. Jean-Jaures, Paris 19e, France

"Rubber and Plastics Age"
Rubber and Technical Press, Ltd.
Tenterden, Kent, England

"SPE Journal"
Security Bank Bldg., Athens, Ohio

"Transactions of the Plastics Institute"
6 Mandeville Place, London W. I.
England



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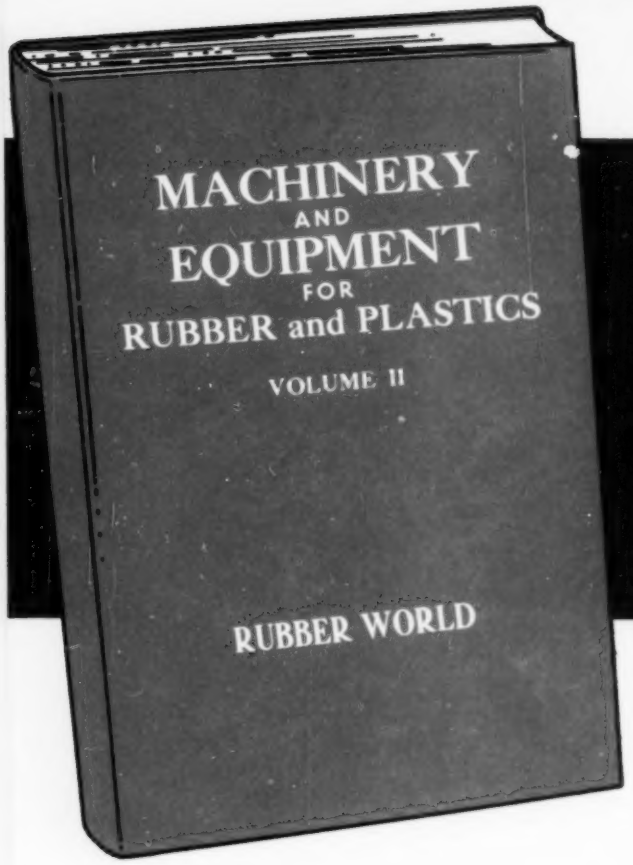

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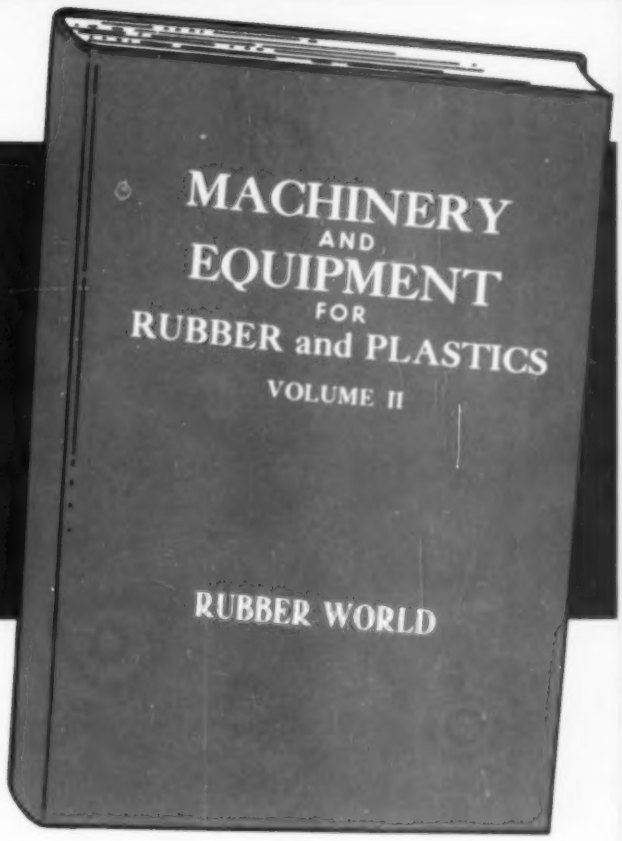

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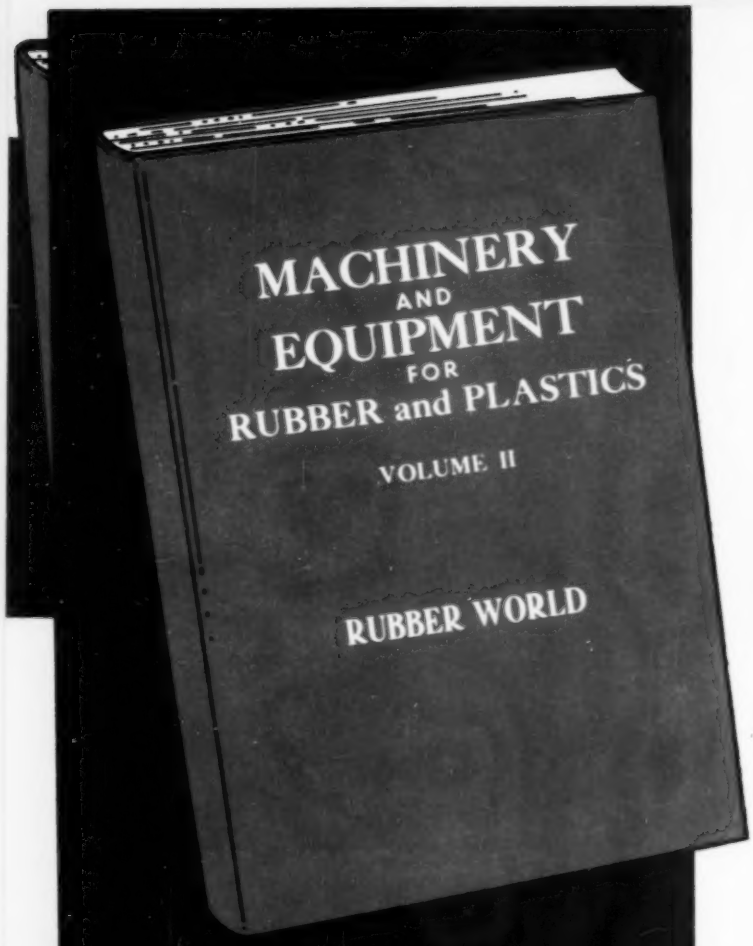

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BILL BROTHERS PUBLICATIONS

"Construction of Polyethylene Containers and Pipe by the Winding Process," G Schulz, *Kunststoffe*, 48, 1, 37 (Jan. 1958).

An attractively simple and efficient method is described for producing large plastic cylindrical containers and wide piping by winding polyethylene strips about a former consisting of a sheet iron cylinder. (In German.)

"Effect of Processing Conditions upon Specific Gravity of High Density Polyethylene," J. P. Fogarty and E. Poindexter, *SPE J.*, 14, 4, 41 (April 1958).

Variables studied for their effects on specific gravity of high-density polyethylene included mold holding time, cylinder temperature, pressure, mold temperature, and annealing procedure.

"Extrusion and Forming of High-Density Polyethylene Blown Tubing," Robert Doyle, *Modern Plastics*, 35, 9, 137 (May 1958).

Tables are given showing the variations in strength properties of blown tubing with sheet thickness and blow-up ratio, and the dependence of cycle times on sheet thickness.

"Automatic Resin Content Control in High-Pressure Laminate Manufacture," H. R. Levine, *Modern Plastics*, 35, 9, 133 (May 1958).

Control of squeeze-roll pressure permits the minimizing of other variables affecting laminate manufacture. Squeeze-roll pressure can be controlled by adjusting the roll gap, using a beta-ray gage to measure sheet density before and after resin impregnation.

"Matching TFE Resins," H. J. Kipnes, *Modern Plastics*, 35, 9, 123 (May 1958).

Machining of TFE is shown to require close control of rod stock quality, and to involve special problems in plastic memory, stress relief, and heat conduction.

Applications

"The Use of Cellulose Nitrate in the Boot and Shoe Industry," N. G. Perkins, *Rubber & Plastics Age*, 38, 9, 799 (Sept. 1957).

Description of the method of using cellulose nitrate in the production of toe puffs (designed to give shape and firmness to the toes of shoes), shoe heels, eyelets, and lace tags.

"Glass-Reinforced Plastics Tanks," W. B. Sanford, *SPE J.*, 14, 4, 52 (April 1958).

This is the fourth in a series of reports giving service experience with glass-polyester and glass-epoxy tanks encountered by Minnesota Mining & Mfg. Co.

"The Case for Alkyds as Electrical Insulation," N. Parkman, *Brit. Plastics*, 30, 11, 483 (Nov. 1957).

This article is based on Technical Reports of the Electrical Research Association. The alkyd types available in the United Kingdom are classified as slow-curing, fast-curing, and self-extinguishing. In addition, their properties are compared with those of Type HD phenolic. It is shown that while the chemical properties of the alkyds vary with type, there are grades with dimensional stability, mechanical strength, and track and discharge resistances up to high voltages and frequencies that make them suited for many applications where the older thermosets are inadequate.

"Plastic Shoe Heels," D. R. Crabtree, *Rubber & Plastics Age*, 38, 9, 795 (Sept. 1957).

Hints on the use of polystyrene in the production of shoe heels.

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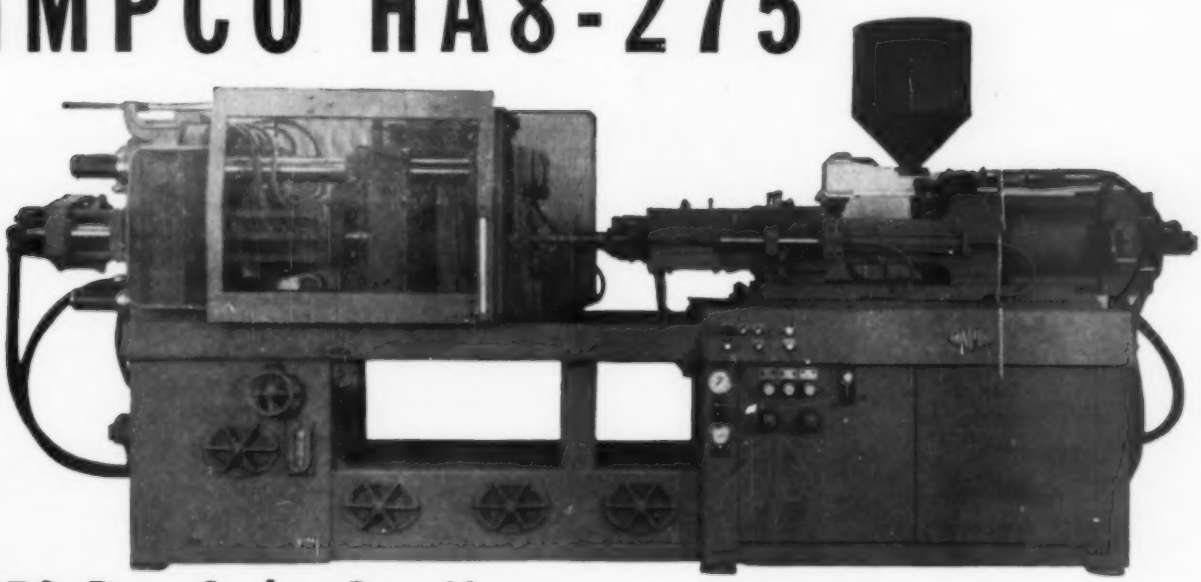

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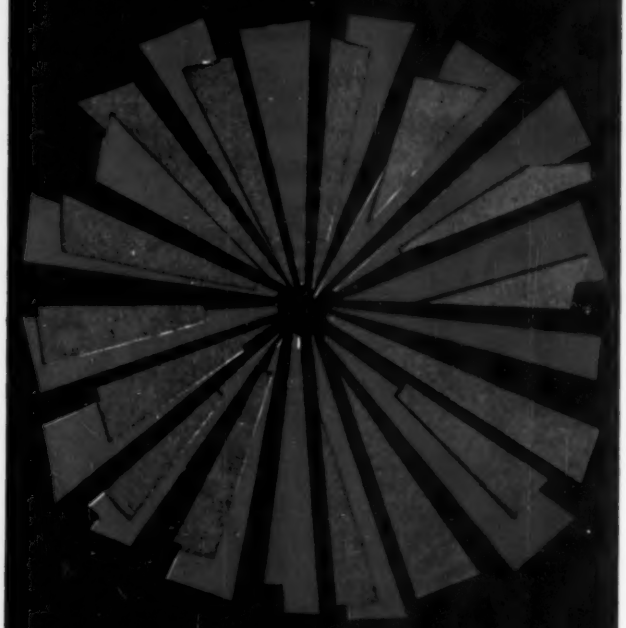

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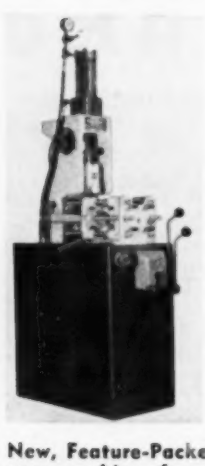

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Patent Digest

Materials

Vinyl Chloride Resin with Lead Salt and Hindered Phenol Stabilizers. No. 2,820,774. Clayton S. Myers, Fanwood, Joseph E. Wilson, New Brunswick, and Robert Bostwick, Somerville, N. J. (to Union Carbide Corp., New York, N. Y.).

To stabilize PVC against chemical and heat degradation, lead is used as the primary stabilizer, and 0.005-0.5% by weight of 2, 3, 6-trialkyl-substituted phenol is used as the secondary stabilizer.

Unsaturated Polyester Room Temperature-Setting Adhesive Composition. No. 2,819,248. George S. Casebolt, Summit, N. J. (to American Cyanamid Co., New York, N. Y.).

The adhesive contains a polymerizable, ethylenically-unsaturated, linear polyhydric alcohol-carboxylic acid polyester; styrene; an organic peroxide- or ozonide-catalyst; and 2-20% by weight of a polyvinyl acetate or acetal.

Ethylene Polymerization. No. 2,819,257. Fred Kagan, Kalamazoo, Mich. (to Standard Oil Co., Chicago, Ill.).

Ethylene is contacted with a free radical-producing polymerization catalyst at a temperature of 20-300° C. Through heat, the catalyst decomposes to form free radicals at a polymerization pressure of about 500 psi. The polymerization should take place in the presence of an inert reaction medium consisting of dimethylenepentylcarbinol; proportion of the latter being at least 10% by weight.

Portland Cement-Vinylidene Chloride Polymer Composition, Method of Making, and Method of Using. No. 2,819,239. John F. Eberhard and Arthur Park, Tulsa, Okla. (to Dow Chemical Co., Midland, Mich.).

The composition comprises a slurry of Portland cement, a vinylidene chloride-acrylonitrile copolymer latex, a nonionic wetting agent, and water.

Method of Making Glass Fiber-Filled Alkyd Resins. No. 2,819,243. Theodore C. Baker, Wayne, O. (to Allied Chemical Corp., New York, N. Y.).

A polymerizable, unsaturated alkyd resin and a finely-divided mineral filler are mixed together in a suitable solvent until the viscosity is just below 25,000 cps. A polymerization catalyst is added, and glass fiber strands 1/10-1 mil in diameter, ¼-2 inches in length, are incorporated into the mixture. Excess solvent is removed to produce a substantially dry mass which is freely permeable by air.

Manufacture of Melamine. No. 2,819,266. John J. Healy, Jr., St. Louis, Mo., and Colver P. Dyer, Winchester, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Urea is charged to one of two pressure-resistant reactors connected in series, and liquid ammonia is charged to the other. The urea is heated to 250-350° C., at a pressure of 600-2,500 psi.; simultaneous adding the ammonia. Melamine will collect in the one vessel, and extraneous matter will collect in the other.

Molding Compositions of Benzoguanamine-Formaldehyde Reaction Product and Butadiene-Acrylonitrile Copolymer Rubber. No. 2,819,246. Richard Lindenfelser, Darien, and Martha K. Layman, Stamford, Conn. (to American Cyanamid Co., New York, N. Y.).

The molding composition comprises a uniform, hot-blended, compatible mixture of a fusible, thermosetting condensation product of formaldehyde and benzoguanamine in a molar ratio of 1-4:1; plus 10-50% by weight of a rubber-like copolymer of butadiene and acrylonitrile.

Manufacture of Melamine. No. 2,819,265. John J. Healy, Jr., St. Louis, Mo., and Colver P. Dyer, Winchester, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Urea and 1-10% by weight of an ammonium halide are heated in a pressure-resistant vessel at a temperature between 300-450° C., and under a pressure of at least 600 psi.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.
—The Editor

Equipment

Machine for Making Shell Molds. No. 2,820,998. Charles R. Harrison, Wesleyville, Pa. (to Harrison Machine Co., Erie, Pa.).

The machine includes a means for holding a heat conducting pattern on a perforated work table in such a position that a cavity is formed between pattern and table; a means for heating the pattern to a temperature sufficient to plasticize the thermosetting material and build up a layer of plasticized sand and resin on the pattern; a sand tube located below the table; a blow head positioned below the sand tube; a means for introducing a blast of air which would drive the mixture upwards through perforations into the pattern cavity; and a means for stopping and reversing the air blast. This latter air blast removes surplus sand and resin which have not adhered to the pattern.

Manufacture of Expanded Materials. No. 2,816,741. Oscar Schuffman, Yonkers, N. Y. (to Hudson Foam Plastics Corp., Yonkers, N. Y.).

An apparatus for mixing foamed plastics consists of a cylindrical mixing chamber to which a number of liquid chemical ingredients are pressure-fed through a plurality of circumferentially spaced openings in the sidewall. A rotatable shaft, extending along the longitudinal axis of the chamber, bears radially projecting pins which agitate the sequentially-introduced liquids. The foamed material is discharged rapidly through a restricted orifice at the bottom.

Means for Applying Printing to Plastic. No. 2,818,799. Henry Milton Hayward, Eastwood, near Sydney, New South Wales, Australia.

This machine for printing on the curvilinear surface of tubular plastic container units serially connected by a seam consists of a frame; upper and lower wheels with hub; wheel-end flanges; circumferentially-spaced parallel pins in the flanges, which provide recesses for receiving the container units; feed table and feed wheel; two printing cylinders; a pair of rotatable unit-locator blades; and means for operating the wheel synchronously, as well as the printing cylinders and locator blades.

Shell Molding Machine. No. 2,820,997. Earl W. Jahn, Springfield, Mass. (to Production Pattern & Foundry Co., Chicopee, Mass.).

The unit comprises a single, pivotally-mounted investment box; a pattern-heating and mold-curing oven on either side of the box; a shell mold ejector; and two pattern carriers which swing out in a horizontal plane about fixed-space centers.

Processing

Process for Extruding Films. No. 2,819,493. Philip Richard Hatwin and Harry Edward Bellairs Young, Spondon, near Derby, England. (to British Celanese, Ltd., a corporation of Great Britain).

A thermoplastic composition is extruded in a temporary, heat-fluidized condition through an aperture which has the form of a straight slit. For a continuous operation, the plastic material is fed along a straight path in the direction of extrusion. Heat along the way converts it to a semi-fluid state, then to a fluid stream; at which time it is bisected longitudinally. These streams are directed along an accurate path at a constant rate, and finally are brought together in a plane before reaching the extrusion slit. The extrudate sets as a film of predetermined width, and is taken up on rolls.

Porous Articles of Fluoroethylene Polymers and Process of Making Same. No. 2,819,209. David B. Pall, Roslyn Heights, and Sidney Krakauer, Franklin Square, N. Y. (to David B. Pall).

A fluid-permeable filter is obtained by sintering a layer of fluoroethylene polymer particles which are confined between non-adhering surfaces. Pressure exerted is about 30-50 psi., and the temperature is above the softening but below the melting/decomposition temperature of the particles.

Method for Producing Polyethylene Foams. No. 2,819,231. Oliver M. Hahn and Harold B. Whitfield, Jr., Wilmington, Del. (to E. I du Pont de Nemours & Co, Inc., Wilmington, Del.).

Solid polyethylene foam is obtained by admixing polyethylene with di-N-nitrosopentamethylenetetramine in the ratio of over 1:2. More polyethylene then is added to raise its percentage to 95-99.5%, and the mixture is extruded as solid foam. Process temperatures should be sufficiently high to produce thermal decomposition of the di-N-nitrosopentamethylenetetramine.

Applications

Plastic Nozzle and Screw Cap Assembly. No. 2,818,204. John Henchert, River Forest, and William F. Punte, Chicago, Ill. (to Continental Can Co., Inc., New York, N.Y.).

The plastic nozzle, which is designed for a container, comprises a tubular body with an outwardly extending abutment flange at its lower end. A closure cap is threadedly mounted on the nozzle and protects it with a skirt-like extension which reaches the abutment flange when the cap is screwed home.

Adhesive Sheet. No. 2,818,169. Milton Alfred Bergstedt, Linden, N. J. (to Permacel Le Page's, Inc., New Brunswick, N. J.).

A pressure-sensitive adhesive is applied to one surface of a flexible, non-fibrous, moisture-sensitive cellulosic backing film, while the opposite surface receives a continuous mirror coating bearing a resinous, binder-ink impression. The mirror coating is made up of at least one member of the group consisting of polyvinyl alcohol, carboxy methyl cellulose, hydroxy ethyl cellulose, methyl cellulose, glue, and casein.

Bottle Closure. No. 2,813,650. Yonendo Takahashi, Nakano-Ku, Yukichi Tanaka, Toshima-Ku, Tokyo, Japan. (to American Cyanamid Co., New York, N.Y.).

Polyethylene or vinyl may be used for the stiff but resilient closure. It includes a slightly-bulging top disc; a hollow, dependent inner stem; an end bevel; an annular ring surrounding the top disc; an exterior skirt shorter than the inner stem; interior and exterior cam beads; vertical corrugations around the exterior skirt; and a lifting tab.

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Patent Digest (Cont'd.)

Low Adhesion Coatings on Adhesive Tapes and Liners. No. 2,816,655. Robert N. Crozier and Angus Norbert MacDonald, Springfield, and Aubrey F. Price, South Hadley, Mass. (to Shawinigan Resins Corp., Springfield, Mass.)

The tape has a cellulosic film backing coated on the inner face with a pressure-sensitive adhesive. The outer face is coated with a low-adhesion composition comprising 1-5 mols of a vinyl ester of a carboxylic acid with one mol of a partial ester of maleic acid.

Impregnating and Molding of Leather. No. 2,836,972. Keith R. Cranker, Trenton, N. J., and Daniel J. Smith, Elkton, Md. (to Thiokol Chemical Corp., Trenton, N. J.).

A liquid polythiol polymer and a curing agent are forced into a leather object by heat and pressure obtained in a mold.

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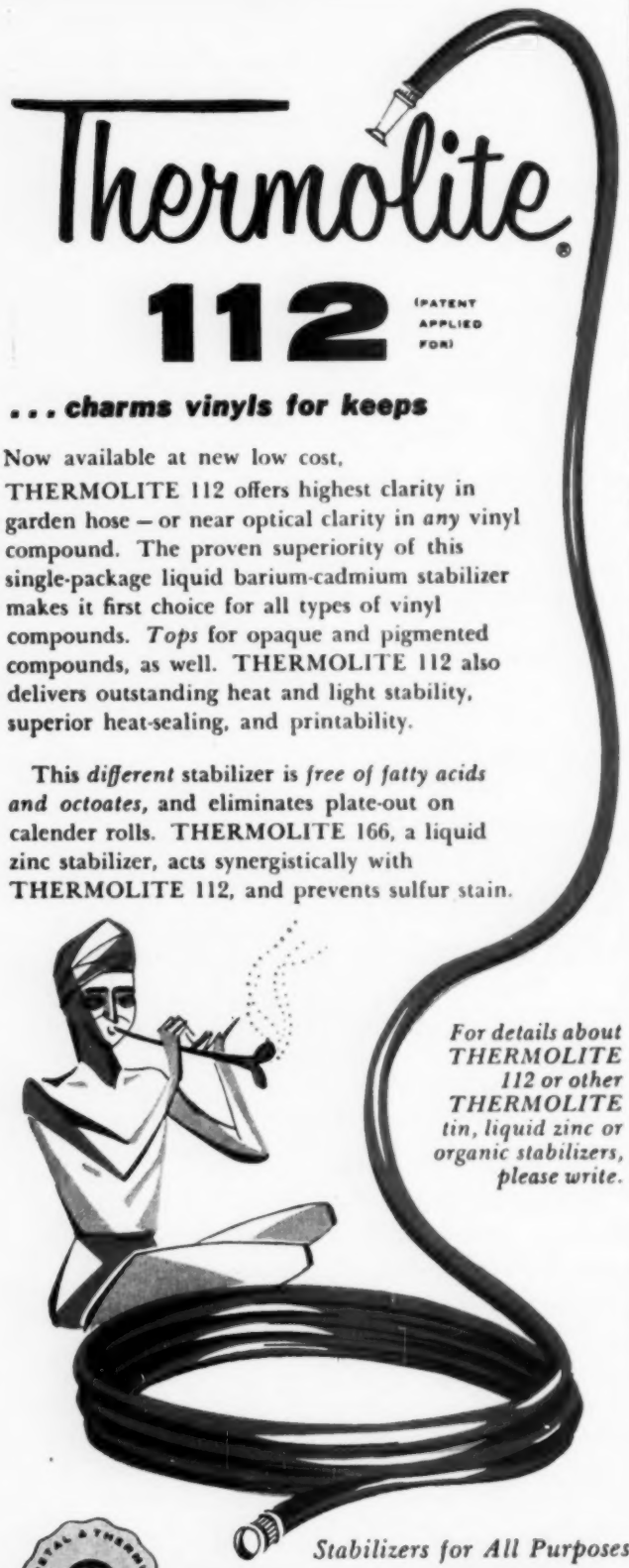

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86	lb.	1.50 /	2.37
87	lb.	.73 /	1.51
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Standard colors	lb.	.65 /	.92
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Aug. 4-8
1956 Gordon Research Conferences on Elastomers and Polymers, University of Rhode Island, Colby Junior College, New London, N.H.

Sept. 7-20
31st Industrial Chemistry Conference of Liege, Federation of Belgian Chemical Industries and the Belgian Branch of the Industrial Chemical Society, Liege, Belgium.

Sept. 12
SPE Detroit Section, Regional Technical Conference, Plastics in Automotive Applications, St. Clair Inn, St. Clair, Mich.

Sept. 22-24
Seventh Annual Meeting, Standards Engineers Society, Benjamin Franklin Hotel, Philadelphia, Pa.

Oct. 1
SPE Western New England Section, Regional Technical Conference, Plastics in Packaging, Hotel Statler, Hartford, Conn.

Oct. 9-10
SPI 14th New England Section Conference, Wentworth-by-the-Sea, Portsmouth, N.H.

Oct. 20-22
13th Tappi Plastics-Paper Conference, Sheraton-Kimball Hotel, Springfield, Mass.

Oct. 21
SPE Upper Midwest Section, Regional Technical Conference, Epoxies, Curtis Hotel, Minneapolis, Minn.

Nov. 13
SPE Southern California Section, Regional Technical Conference, Plastics in Building and Construction, Ambassador Hotel, Los Angeles, Calif.

In Brief . . .

The General Tire & Rubber Co., Textileather Division, Toledo, O., has appointed McGreevy Associates, Boston, Mass., as its New England sales agents.

Synthane Corp., Oaks, Pa., has relocated its Cleveland, O., sales office to 3597 Lee Road, about eight miles east of the city's downtown area. The office formerly was in the Western Reserve Building, Cleveland.

Domestic Production and Sales of Plastics and Resin Material, January and February, 1958

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of January and February, 1958. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Production and sales totals for cellulosics, phenolics, ureas, and melamines are considerably below those for the same period in 1957. Polyesters have been moving faster and polyethylene continues to climb both with respect to last years figures and also as compared to last month's report. The latter case reflects the wide acceptance of the newly developed high-density materials.

	January, 1958		February, 1958	
	Production	Sales	Production	Sales
Cellulose Plastics[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,288,978	1,214,284	1,230,072	1,225,058
Sheets, 0.003 gage and over	1,498,848	1,199,195	1,471,308	1,281,589
All other sheets, rods, and tubes	776,656	556,856	581,990	662,068
Molding and extrusion materials	6,136,117	6,433,269	6,677,428	6,427,460
Nitrocellulose sheets, rods, and tubes	347,777	376,441	289,763	290,594
Other cellulose plastics	873,721	693,027	671,334	431,609
TOTAL	10,924,097	10,473,072	10,921,895	10,318,378
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	15,722,895	13,087,269	13,213,497	11,799,337
Bonding and adhesive resins for—				
Laminating (except plywood)	4,989,267	3,196,671	4,945,921	3,198,309
Coated and bonded abrasives	1,360,446	915,677	972,717	889,031
Friction materials (brake linings, clutch facings, and similar materials)[7]	1,306,279	968,829	1,016,193	1,006,291
Thermal insulation (fiber glass, rock wool)	4,346,400	3,685,869	3,276,260	3,036,720
Plywood	4,068,726	3,546,982	3,581,360	2,627,731
All other bonding and adhesive uses	4,028,616	3,627,084	3,060,380	3,098,842
Protective-coating resins, unmodified and modified except by rosin	2,292,458	2,091,595	2,368,767	1,708,074
Resins for all other uses	2,990,804	2,115,098	2,433,822	1,666,134
TOTAL	41,105,891	33,235,074	34,868,917	29,030,469
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	3,176,613	3,031,769	2,854,720	2,863,006
Paper-treating and paper-coating resins	2,413,001	1,799,663	2,241,991	1,708,054
Bonding and adhesive resins for—				
Plywood	7,664,202	6,987,934	6,247,320	6,611,495
All other bonding and adhesive uses, including laminating	3,424,713	2,720,240	2,852,810	3,347,984
Protective-coating resins, straight and modified	2,615,959	1,926,208	2,090,887	1,695,607
Resins for all other uses, including molding	8,951,057	8,914,547	7,673,861	7,099,502
TOTAL	28,245,545	25,380,361	23,961,589	23,325,648
Styrene Resins:				
Molding materials[1]	28,549,783	33,084,437	29,656,232	33,427,954
Protective-coating resins, straight and modified	7,689,571	7,233,175	7,496,527	6,772,902
Resins for all other uses	13,150,839	10,684,523	12,559,932	9,968,793
TOTAL	49,390,193	51,002,135	49,712,691	50,169,649
Vinyl and Vinyl Chloride Resins[2]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		5,870,418		5,901,555
Sheeting (resin content)		4,119,278		4,411,752
Molding and extrusion (resin content)		16,361,113		13,907,314
Textile and paper treating and coating (resin content)[8]		4,035,242		4,468,201
Flooring (resin content)		7,561,963		7,964,130
Protective coating (resin content)		2,884,703		2,249,691
All other uses (resin content)		4,070,853		3,368,879
All other vinyl resins for—				
Adhesives (resin content)		3,213,431		3,484,361
All other uses (resin content)		10,779,709		9,192,989
TOTAL	68,976,734	58,896,710	58,326,883	54,948,872
Coumarone-Indene and Petroleum Polymer Resins	18,519,497	18,506,092	18,350,270	18,180,119
Polyester Resins:				
For reinforced plastics	6,738,073	6,247,896	7,197,778	6,537,073
For all other uses	795,007	715,425	712,057	683,759
TOTAL	7,533,080	6,963,321	7,909,835	7,220,832
Polyethylene Resins:				
For film	15,668,049	28,175,990	13,602,498	18,447,516
For all other uses	53,854,215	34,454,913	48,221,592	35,932,446
TOTAL	69,522,264	62,630,903	61,824,090	54,379,962
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[3, 4]	3,522,317	3,651,986	2,921,828	3,075,536
Protective-coating resins[5]	1,045,880	641,402	861,179	538,037
Resins for all other uses[6]	12,154,884	9,458,721	10,179,049	9,240,518
TOTAL	16,723,081	13,752,109	13,962,056	12,854,091
GRAND TOTALS	310,940,382	280,839,777	279,838,226	260,428,020

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
[7]Included with "All other bonding and adhesive uses."

SOURCE: United States Tariff Commission, Chemical Division.

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